Determination of the 1984 Salmon Escapement to Somass River System

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ABSTRACT

Lightly, D. T., T. F. Shardlow, and A. Y. Fedorenko. 1988. Determination of 1984 chinook salmon escapement to Somass River system. Can. MS Rep. Fish. Aquat. Sci. 1982: 104 p.

The chinook salmon spawning escapement to the Somass River system was intensively studied for the first time in 1984. Three indices of abundance were used: fishway counts, dead pitch recoveries and Petersen mark/recapture. The results showed a river escapement of 56,000 fish which is an order of magnitude greater than earlier estimates. There were an estimated 448 adipose marks in the river and hatchery spawning population. The age composition, based on dead recovery data, was age two - 5% , age three - 11% , age four - 69% , and age five - 14%. The number of chinook in the escapement originating from natural spawning was estimated between 18,000 and 41,000 fish.

RÉSUMÉ

Lightly, D. T., T. F. Shardlow, and A. Y. Fedorenko. 1988. Determination of 1984 chinook salmon escapement to Somass River system. Can. MS Rep. Fish. Aquat. Sci. 1982: 104 p.

En 1984, on a étudié pour la première fois de façon poussée l'échappée du saumon rouge dans le système de la rivière Somass. Trois indices d'abondance ont été utilisés: dénombrements aux échelles à poissons, nombre de poissons morts capturés aux fosses et nombre de poissons porteurs d'étiquettes Petersen recapturés. Les résultats révèlent que l'échappée s'élève à 56 000 poissons, soit une valeur supérieure aux estimations précédentes. On a détermine la présence de 448 saumons porteurs d'étiquettes métalliques codées dans la population génitrice dont la composition selon l'âge est la suivante: 2 ans - 5%; 3 ans - 11%; 4 ans - 69% et 5 ans - 14%. Le nombre estimatif de saumons rouges provenant de la fraie naturelle et présents dans l'échappée varie de 18 000 à 41 000 poissons.

INTRODUCTION

The 1984 spawning escapement of chinook salmon to the Somass River system (Fig. 1) was evaluated as part of the Chinook Key Stream Program conducted by the Department of Fisheries and Oceans (DFO) for assessing the chinook stock rebuilding efforts on the Pacific coast.

The chinook in the Somass River system are the most abundant stock of this species on the Vancouver Island, with the annual river escapement estimates averaging about 10,000 spawners (Fig. 2, Table 1). The Robertson Creek Hatchery production commenced in 1972 and produced a maximum of 45,000 returns in 1982 (Fig. 2, Table 1). The chinook from the Somass River system make an important contribution to net, troll and sport catches in the Alaska, British Columbia and Washington fisheries. Catch data for this stock are used as a model to estimate the catch contribution of numerous other stocks to these fisheries. Sibert and Schnute (1982) conducted an extensive analysis of the chinook returns to Alberni Inlet and Somass system; their analysis was incomplete due to lack of reliable data on escapement, Indian food fishery, and saltwater and river sport fisheries. As a result, several investigations were undertaken in 1984 to provide a more complete data base for assessing the dynamics of this stock. Studies included investigation of native fishery (Anon. MS 1984), Alberni Inlet sport fishery (DFO, unpubl. data), river sport fishery (Anon. MS 1985) and river escapement.

The present report deals with the determination of spawning escapement to the Somass River system and related biological information. The objectives of the study were:

1. to estimate the total chinook escapement to the system,

2. to determine the age and sex composition of naturally spawning population and

3. to estimate the total escapement of coded wire tagged chinook to the system, thereby assessing the contribution of hatchery and natural production to the total escapement and to various fisheries.

Three main approaches were taken in this study: a mark/recapture program, a fishway count, and a river dead recovery. The general design of the mark/recapture program followed the Petersen population estimate method outlined in Ricker (1975). Adult chinook were tagged as close to the mouth of the river as possible, and the tag rate observed at the fishway, in the river dead recovery and at the hatchery rack. Petersen estimates of chinook population in the tagging area were based on these tag occurrence rates.

In this report, tagged chinook refer to fish with spaghetti tags, and marked chinook refer to fish with adipose clips and coded wire tags (CWT).

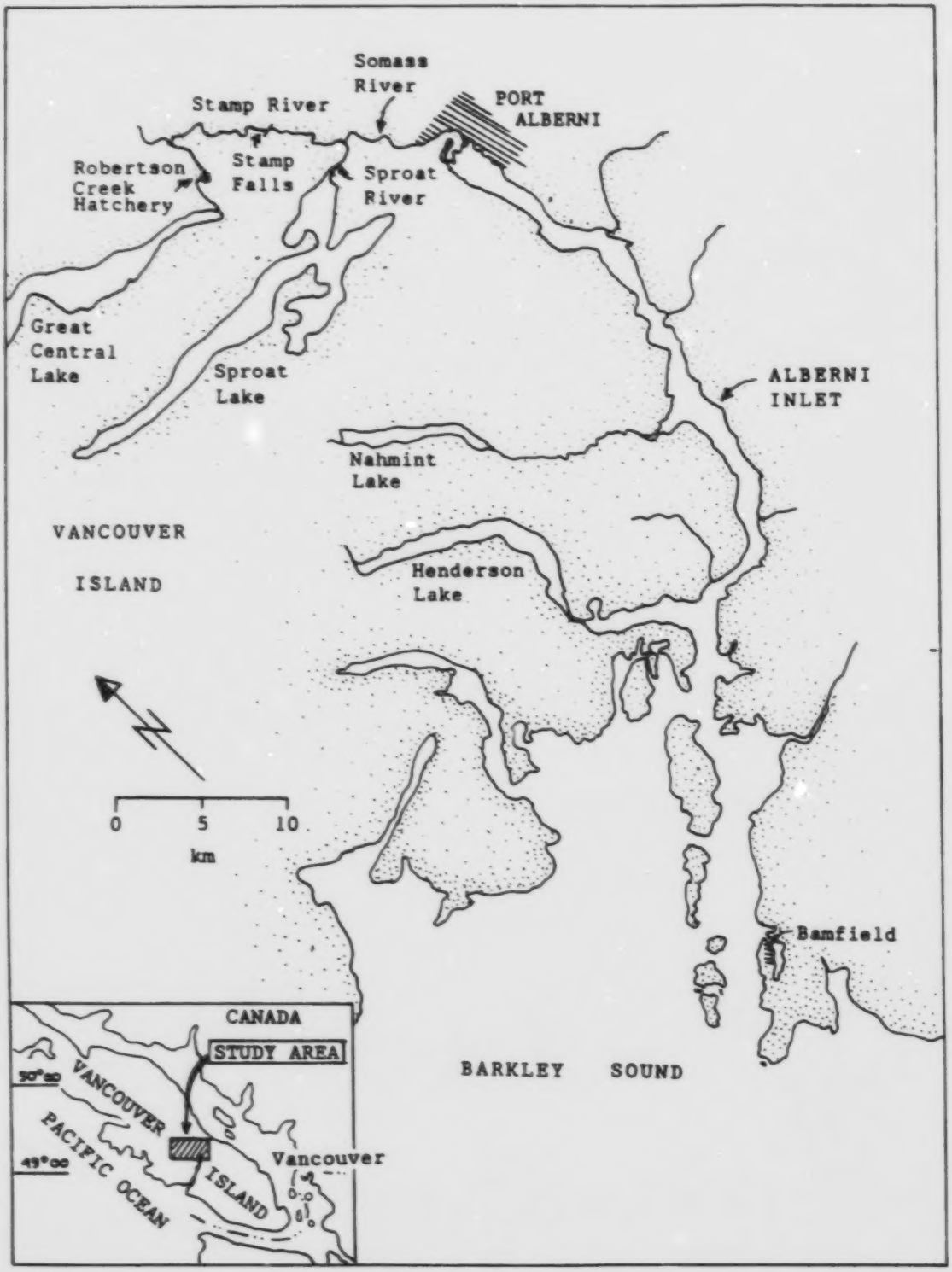

Fig. 1. Location of the Somass River system and Alberni Inlet.

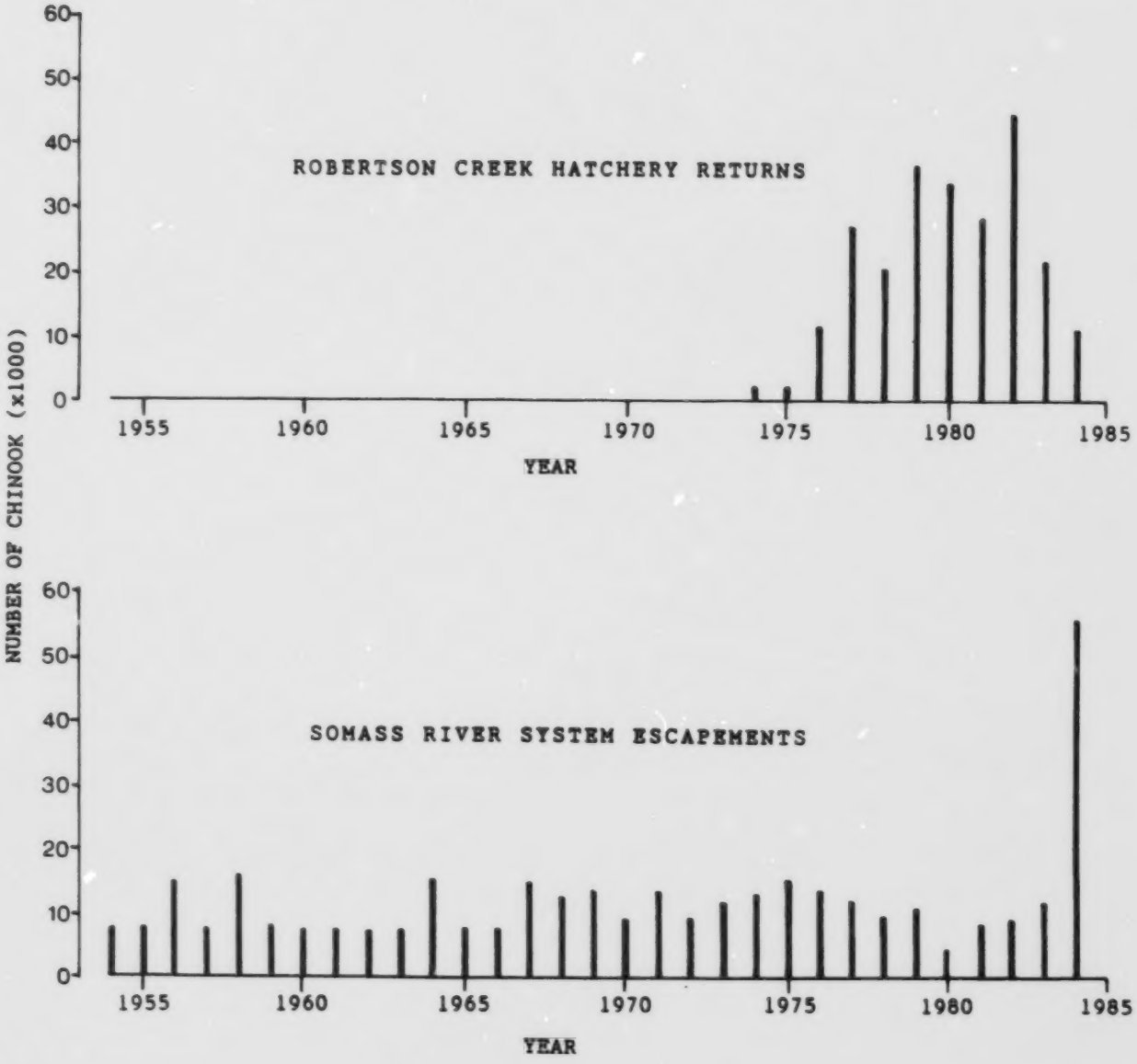

Fig. 2. Annual chinook returns to the Robertson Creek Hatchery, 1974 - 1984, and estimated chinook escapements to the Somass River system, 1954-1984.

Table 1. Annual chinook returns to the Robertson Creek Hatchery, 1974 - 1984, and estimated chinook escapements to the Somass River system, 1954 - 1984.

Year	River[a]	Hatchery[b]
1954	7,500	
1955	7,500	
1956	15,000	
1957	7,500	
1958	15,000	
1959	7,500	
1960	7,500	
1961	7,500	
1962	7,500	
1963	7,500	
10-year Average	9,000	
1964	15,000	
1965	7,500	
1966	7,500	
1967	15,000	
1968	12,500	
1969	13,000	
1970	8,500	
1971	13,500	
1972	9,000	First release of chinook smolts
1973	11,000	0
10-year Average	11,250	0
1974	12,500	1,858
1975	15,000	1,953
1976	13,000	11,761
1977	12,300	27,540
1978	9,000	20,443
1979	10,200	36,465
1980	4,000[c]	34,295
1981	7,500	27,887
1982	8,474	44,932
1983	11,000	21,091
10-year Average	10,997[d]	22,823
1984	56,000	11,032

[a]Data from DFO spawning files; 1984 escapement based on Petersen population estimate.
[b]Data for 1974 - 1976 from Sibert and Schnute (1982); data for 1977-1984 from DFO Mark Recovery Data Base.
[c]Incomplete survey.
[d]Incomplete 1980 escapement excluded.

STUDY AREA

The following description of the study area was extracted from Sibert and Schnute (1982). The Somass River system is located on the southwest coast of Vancouver Island in British Columbia (Fig. 1). The Somass mainstem receives two main tributaries, Stamp River which drains the Great Central Lake and Sproat River which drains the Sproat Lake. The Somass River enters the head of Alberni Inlet, a fjord about 50 km long and 1-2 km wide which connects to the Pacific Ocean through Barkley Sound (Fig. 1).

The Robertson Creek Hatchery is located about 20 km from the tide water on a tributary of the Stamp River (Fig. 1). A dam on Stump River is designed to provide a minimum flow of 800 cfs (22.6 m^3/s) in the lower Somass River.

METHODS

POPULATION ESTIMATES

Chinook spawning population in the Somass River system was determined using the "standard" Petersen estimate where live fish were tagged and carcasses examined for tags in the river and at the hatchery. The following formula was used for an adjusted Petersen population estimate (Ricker 1975):

$$(1) \quad N = \frac{(M + 1)(C + 1)}{(R + 1)}$$

where
- N = Petersen estimate,
- M = Number of fish tagged,
- C = Number of carcasses examined, and
- R = Number of tagged fish recovered.

The 95% confidence limits for N were calculated using the 95% confidence limits of R as determined from the Poisson frequency distribution using formula (2) below (see also Appendix II in Ricker 1975):

$$(2) \quad \text{For } 1\text{-}P = 0.95 \text{ use: } R + 1.92 \pm 1.960\sqrt{R + 1.0}$$

The upper and lower limits of R were then substituted into formula (1) above, and corresponding limits for N were obtained.

The estimated spawning population was adjusted downward to correct for local native and sport catches. Native catch data were obtained from the 1984 survey of the Indian food fishery in the Somass River (Anon. MS 1984);

sport catch data were obtained from the 1984 sport creel surveys for the upper Alberni Inlet (DFO, unpubl. data) and the Somass River system (Anon. MS 1985).

Assumptions

Conditions which must be met for the Petersen method to be effective and which apply to this study are as follows:

1. Tagged and untagged fish must have the same mortality rate.

2. Tagged fish must not lose their tags.

3. Tagged and untagged fish must be equally vulnerable to the recovery effort and to fisheries.

4. All tags must be recognized and reported.

5. Tagged fish must become randomly mixed with the untagged population, or the recovery effort must be randomly distributed throughout the entire spawning population.

The experiments conducted to quantify items 1 and 4 are described below. Other assumptions are dealt with in the Results and Discussion sections.

Tagging/handling mortality: During live tagging in Alberni Harbour, post-tagging mortality was assessed in two separate experiments by holding tagged and untagged fish in net pens for three days following capture. In the first test, 20 tagged chinook were placed in a 3 m x 3 m x 2 m floating net pen, while 20 untagged fish were placed in an identical adjacent pen. Fish removed from the seine net were placed alternately into one of the two pens. The fish for this test were captured near the head of the inlet and the pens were secured inside the log booms at the Alberni plywood mill (Fig. 3). The fish were left in the pens for three days and checked daily for mortality.

In the second test begun 10 days later, 20 tagged and 20 untagged chinook were alternately placed in a single 3 m x 3 m x 3 m net pen. The fish were captured and tagged at the head of the Alberni Inlet near Hohm Island and the pen with fish was towed slowly across the inlet to the outer end of the McClelland contracting wharf (Fig. 3). The pen was sunk to a depth of 3 m and left for three days, at which time the results were assessed and the survivors released.

Non-detection/non-reporting of tags: As part of this study, a general non-detection/non-reporting of tags was assessed by conducting an experiment in 1984 at the Big Qualicum River spawning channel. Chum were enumerated in a dead pitch and every fish removed, examined for tags and trucked away. As part of this experiment, at peak die-off on November 28, 1984, 200 carcasses were spaghetti-tagged and distributed throughout the channel. This was done under cover of night and without the knowledge of the dead pitch crew. The crew was earlier informed that tags would be showing up in the channel and the finder of most tags will receive a large bottle of fine Canadian whiskey.

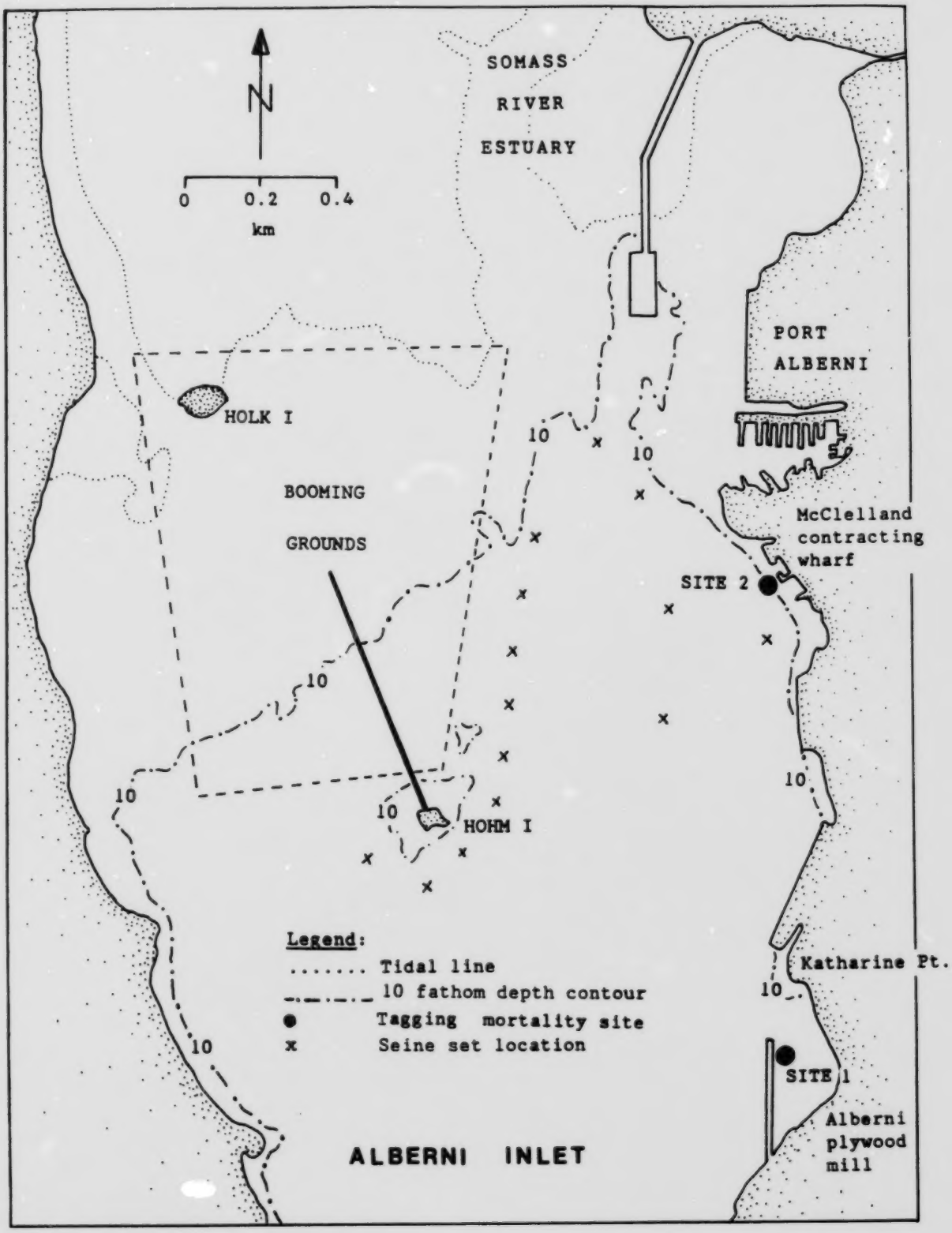

Fig. 3. Location of chinook tagging sets and tagging mortality study sites in Alberni Harbour, 1984.

LIVE TAGGING

Chinook adults were seined for tagging near the head of Alberni Inlet (Fig. 3) between September 4 and October 5, 1984. Fish were captured using a 150 m long by 14 m deep seine net operated from the DFO vessel RD 104. The mesh size of the net ranged from 2.5 cm at the lead end to 1.3 cm at the bunt end. To avoid snagging, the operation was conducted outside the 10 fathom depth contour (Fig. 3). On the last day of the operation, 10 sets captured only one chinook and no visual sightings of fish were made.

Chinook schools were located either visually or by echo sounder. To minimize fish stress from crowding, a net catch was generally limited to 30-50 fish. Larger catches were usually released. During tagging, the skiff was held 2 m away from the boat and the net drawn up between. All fish were tagged while still in the water. One person held the fish by the caudal peduncle while another inserted the tag. Only fish which showed minimal signs of stress were tagged. After tagging, chinook were eased over the corkline and released. The color coded spaghetti tags were 50 cm long. They were inserted by a needle through the dorsal surface of chinook just behind the dorsal fin and tied over the back with a reef knot. Six color codes were used in order to study the migration and spawning timing of different segments of the run. This plan was subsequently abandoned due to severe October flood conditions which delayed the migration timing of a large portion of the run.

Daily tagging records included numbers of chinook tagged by color, adipose marks observed, and incidental salmonid catches by species.

FISHWAY COUNTS

Visual counts of salmonids passing through the Stamp Falls fishway (Fig. 4) were made between September 6 and November 6, 1984. The fishway used a vertical slot design and originally had two entrances, one for low and one for high water level. The high water portion of the fishway had fallen into disrepair and was not passable during the study period. A counting station was installed at the head of the fishway and is shown diagrammatically in Appendix Fig. 1. An iron gate, 2.4 m wide by 2 m high, with bars spaced 2.7 cm apart, was placed in the fishway. A secondary gate was placed at the bottom of the larger gate, forcing the fish to pass across a 1 m wide white flashboard. The secondary gate had an opening 0.3 m high and 1.3 m wide, and was designed to prevent multi-layered schools of fish from entering, thereby facilitating counting and species identification. The secondary gate could be closed to prevent passage when the station was unmanned. To improve visibility, a 3 m by 1.2 m viewing window was floated on the surface over the flashboard. The counter observed the fish from a shed located to the side of the fishway and above the floating window. To prevent glare, a canopy made of translucent fibreglass sheets was constructed over the fishway at the counting site.

The normal operating procedure was to open the gate at dawn and count all the fish passing through until dusk when the gate was shut. Under

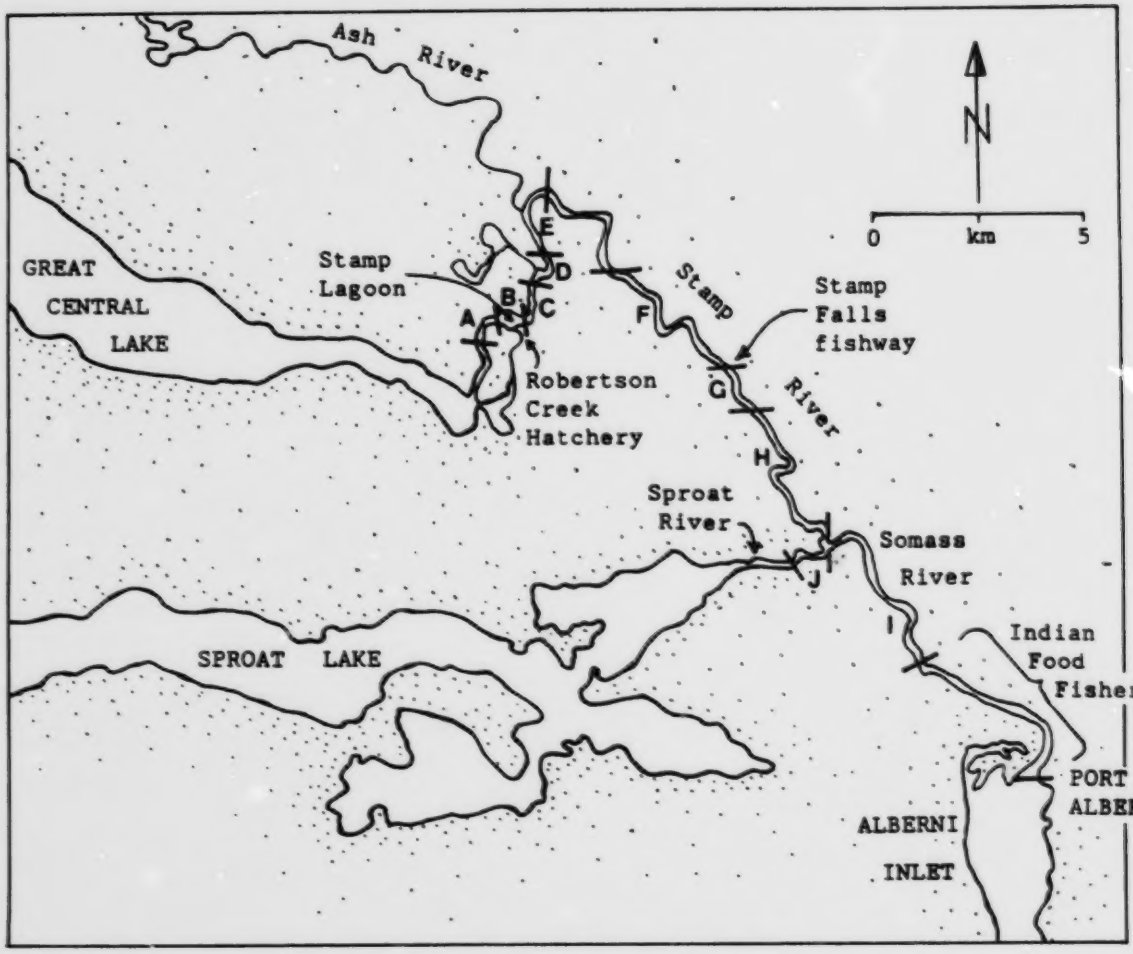

Fig. 4. Somass River system showing location of Stamp Falls fishway and river recovery sections (A-J), 1984.

this schedule, two shifts of two counters each were required. When 24-hour counts were made, three shifts of two counters each were required. In all cases, the two counters on duty made alternate half-hour counts. Fish migration was interrupted by a severe flood from October 7 to 18 (see Results section for details.) From October 19 to 25, counting was conducted during daylight hours but the gate remained open at all times. From October 26 to 28, 24-hour counts were made. Subsequent to this, only one counting shift operated during the peak daytime migration hours with the gate remaining open at all times.

Although the counters had some familiarity with fish identification, most having worked at the Robertson Creek Hatchery, further training was required. This was provided by R. Traber of the Fisheries Research Branch who, during the first day of counting, pointed out the various species of fish passing and discussed their characteristics with the counters. He returned on September 12 and October 3 and conducted further instruction, as well as independent parallel counts. These counts were designed to measure any observer error in the routine enumeration.

Daily fishway records included total counts of chinook and other salmonids by species, and numbers of tags by color; no records were kept of adipose-clipped chinook due to difficulty in detecting these marks at the fishway.

DEAD RECOVERY

River recovery

Dead recovery in the Somass River system was conducted between October 23 and November 26, 1984. The river was divided into 10 sections (A-J, Fig. 4) based on accessibility and natural topography. The reach between sections E and F was not surveyed since the habitat there is unsuitable for spawning and few adults use that section. Carcasses were recovered primarily by walking the streambank and shallows, and by SCUBA diving in deep pools located in sections B (Stamp Lagoon), D and E where large numbers of carcasses had accumulated. Limited snorkeling and gaffing from a boat were also conducted.

Carcasses recovered by walking, snorkeling and boating were examined for sex, missing adipose fins, and presence of spaghetti tags by color, then cut in half to prevent double counts. A portion of the recovered carcasses were also sampled for scales, and all females recovered by walking were assessed for spawning success (see Biological Sampling section).

The SCUBA diving recovery consisted of tossing individual carcasses downstream from the main pile, while keeping a record of males, females and jacks, missing adipose fins, and presence of spaghetti tags by color. Carcasses recorded during diving were not cut in half. However, their resampling was unlikely since the recovery program was to terminate within a week and the current in the pools was considered too slow for any significant downstream dislodging of carcasses to occur.

Chinook with missing adipose fins had their snouts (heads) removed, and these were placed in a bag with a numbered label. The heads were stored frozen at the Robertson Creek Hatchery until the end of the project, then transported to the DFO Tag Recovery Laboratory in North Vancouver for dissection and tag decoding. Only the walking recoveries were processed in this manner; diving recoveries were recorded for a missing adipose fin but no heads were retained.

Hatchery returns

The staff at the Robertson Creek Hatchery enumerated all chinook returning between August 23 and December 4, 1984. Daily records included numbers of males, females and jacks, missing adipose fins, and presence of spaghetti tags by color. No random or systematic scale samples were taken from the hatchery returns. Thus no estimate of the age composition of the unmarked hatchery returns was available.

The heads from adipose marked chinook were removed and transported to the DFO Tag Recovery Laboratory in North Vancouver for dissection and tag decoding.

BIOLOGICAL SAMPLING

All chinook recovered in the river and at the hatchery were recorded as to males, females and jacks. Scales were sampled only during the river dead recovery program when 325 chinook carcasses were sampled randomly throughout the population between November 2 and 21, 1984. Five scales per fish side were removed from the preferred area and placed into gummed scale books. The scales were processed at the DFO Scale Laboratory in Vancouver.

Spawning success of chinook females was assessed only for walking recoveries. Fish were cut in half and examined. Those which retained all or most of their eggs were classified as unspawned.

RESULTS

LIVE TAGGING

Daily numbers of chinook tagged at the head of Alberni Inlet, numbers of adipose marks observed, and incidental catches of other salmonids by species are shown in Table 2. Tagging occurred on 10 separate occasions between September 4 and 29, when 3 to 295 chinook were tagged each day (Fig. 5). Of the total 704 chinook tagged, 18 had a missing adipose fin.

Table 2. Daily numbers of chinook tagged in Alberni Harbour and incidental salmonid catches, 1984.

Date	Set No.	Chinook tag color	Chinook numbers tagged	Chinook cumul.total by color	Chinook adipose marks	Incidental catch		
						Sockeye	Coho	Steelhead
Sep 04	1		0	0	0	1	1	0
	2		0	0	0	0	0	0
	3		0	0	0	0	0	0
	4		0	0	0	0	0	0
	5	white	14	14	0	0	0	0
	6	white	24	38	0	0	0	0
Sep 05	1	white	1	39	0	0	0	0
	2	white	4	43	0	0	0	0
	3	white	10	53	1	0	1	0
	4	white	3	56	0	0	1	0
	5	white	8	64	0	0	1	0
	6	white	25	89	0	0	1	0
	7	white	17	106 white	1	0	1	0
Sep 11	1	red	20	20	0	0	0	0
	2	red	0	20	0	0	0	0
Sep 12	1	red	0	20	0	0	0	0
	-	red	9	29	0	0	0	0
Sep 13	1	red	3	32	0	0	3	1
Sep 14	1	red	2	34	0	0	2	1
	2	red	9	43	0	0	0	0
	3	red	62	105 red	0	0	0	0
Sep 18	1	blue	21	21	1	0	1	0
	2	blue	9	30	0	1	0	0
	3a	blue	135	165 blue	2	0	0	0
	3b	pink	130	130 pink	5	0	0	0
Sep 19	1	red/white	0	0	0	0	0	0
	2	red/white	0	0	0	0	0	0
	3	red/white	19[a]	19	0	0	0	0
	4	red/white	21	40	1	0	0	0
	5	red/white	85	125 red/white	3	0	2	0
Sep 28	1	red/yellow	0	0	0	0	0	0
	2	red/yellow	29	29	1	0	0	0
	3	red/yellow	25	54	1	0	0	0
Sep 29	1	red/yellow	0	54	0	0	0	0
	2	red/yellow	19[b]	73 red/yellow	2	0	0	0
Oct 05	1		0	0	0	0	0	0
	2		0	0	0	0	0	0
	3		0	0	0	0	0	0
	4		0	0	0	0	1	0
	5		0	0	0	0	0	0
	6		0	0	0	0	1	0
	7		0	0	0	0	0	0
	8		0	0	0	0	0	0
	9		0	0	0	0	0	0
	10		0	0	0	0	0	0
Total			704	704	18	2	16	2

[a]These fish released on September 22 (tagging mortality study).
[b]Nine of these fish released on October 2 (tagging mortality study).

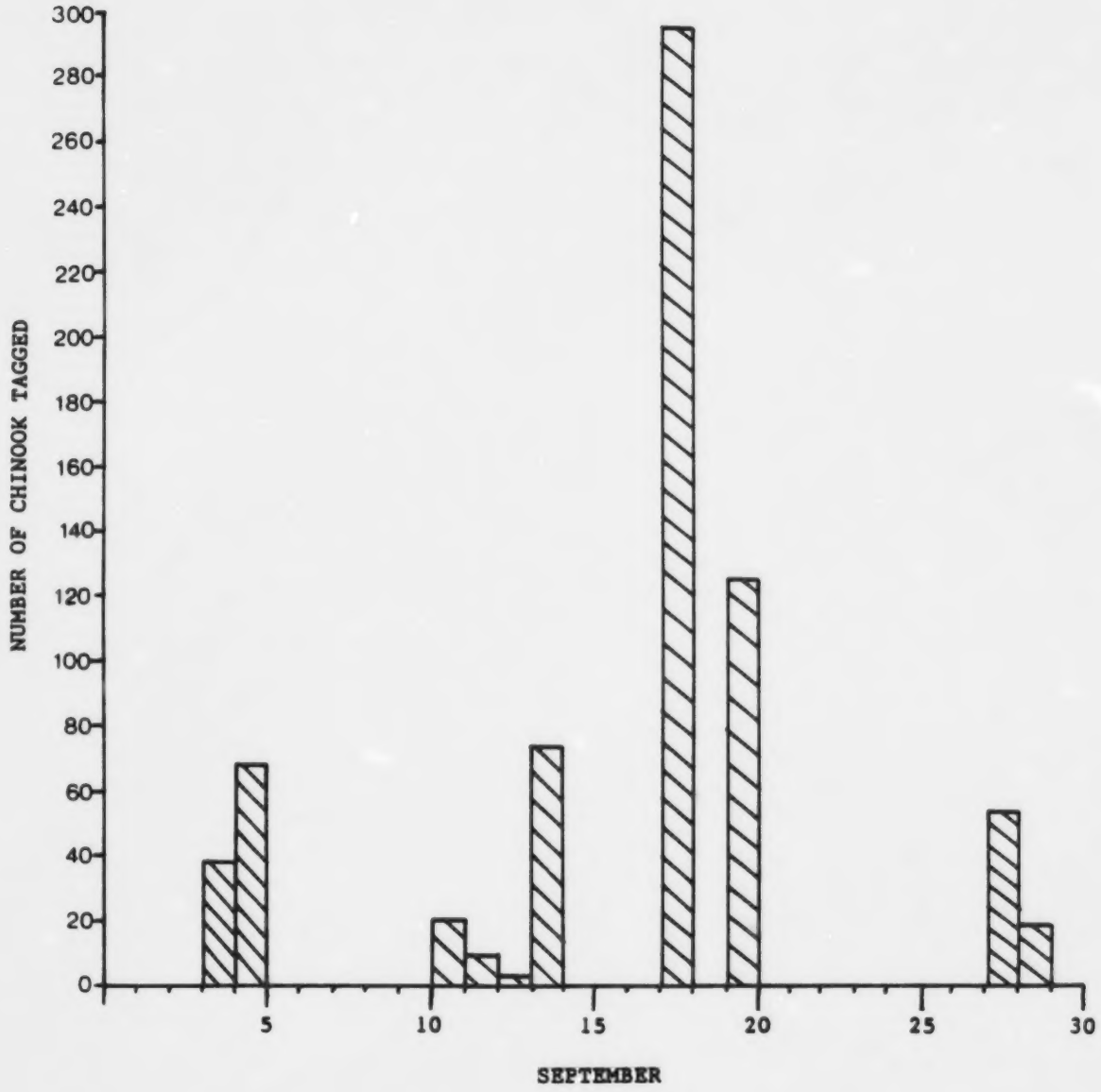

Fig. 5. Daily numbers of chinook spaghetti-tagged in Alberni Harbour, 1984.

FISHWAY COUNTS

Daily counts of chinook passing through the Stamp Falls fishway, numbers of spaghetti tags observed and the incidence of other salmonids by species are summarized in Table 3 and shown by half-hour intervals in Appendix 2. Between September 6 and November 6, 1984, a total of 63,776 chinook, 54,654 coho, 22,500 sockeye and 4,213 steelhead were counted at the fishway. The chinook total included 122 spaghetti tags.

Precision of counts

Two factors were considered in assessing the precision of fishway counts. The first involved observer error in enumerating the fish and in separating the various species. The second involved both upstream and downstream passage of fish over Stamp Falls outside the fishway.

Observer error: Observer error was determined by comparing the independent counts made simultaneously by the instructor and by regular observers on September 12 and October 3 (Table 4). Compared to the instructor's counts of chinook, observer error was less than ± 10%. However, observer error in the separation of the species of similar size, i.e. coho adults, sockeye, and steelhead was considerably higher and ranged between -47.1% to +19.9%. Observers overestimated the total fish count by 2.8%.

Bypassing and multiple passage of the fishway: The problem of upstream and downstream fish passage over Stamp Falls has two components. Bypassing the fishway will occur if some chinook succeed in ascending the falls and are missed in the fishway counts, thereby underestimating the upstream escapement. Multiple passage of the fishway will occur if a portion of chinook that have ascended the fishway are washed back over the falls. This will result in overestimation of upstream escapement whether these fish remain below the falls to spawn and die, or reascend the falls and are counted again. No quantitative measure of bypassing and multiple passage of fishway was available (see Discussion section for indirect evidence) but either event would tend to cancel the effect of the other. Thus, the direction of the overall bias in the fishway counts was unknown.

Incomplete counts

During the fishway enumeration program, there were periods when the gate was open but no counts were taken (Appendix 3). The first of these periods occurred between September 20 and 21 when the control works at Great Central Lake released water and the levels in the fishway rose from 4.1 to 8.0 units. At the same time, turbidity and a fracture of the viewing window reduced visibility to near zero. The gate was open during the daylight hours but no counts were possible, although fish could be seen surfacing in the fishway.

The second major disruption of fishway counts occurred between October 7 and 19 when severe flood conditions resulted in a sharp rise in daily discharge (Appendix 4). On October 7, the water level rose from 3.6 to 9.5 units and continued to rise, flooding the fishway and destroying the

Table 3. Daily salmonid counts at the Stamp Falls fishway, 1984 (expanded counts are explained in footnotes).

Date	Chinook adults and jacks	Chinook cumul.	Chinook tag colors[a] W	R	B	P	R/W	Y/R	Coho adults	Coho jacks	Sockeye	Steelhead
Sep 06	90	90							335	21	514	85
07	141	231							406	33	371	70
08	89	320							468	36	249	178
09	113	433							596	58	307	110
10	614	1,047							1,330	129	871	256
11	242	1,289							950	145	485	128
12	421	1,710							1,348	143	604	107
13	230	1,940							900	102	484	65
14	317	2,257							1,281	142	547	95
15	162	2,419							1,043	68	655	113
16	1,813	4,232							1,733	67	1,506	473
17	1,853	6,085							2,741	145	1,202	266
18	940	7,025	1						2,636	142	1,024	155
19	430	7,455	1						1,698	154	598	85
20	799[b]	8,254							2,270	159	718	108
21	799[b]	9,053							2,270	159	718	108
22	1,168	10,221							2,143	258	665	129
23	2,563	12,784	1						2,602	83	584	64
24	1,911	14,695	1		1				1,362	131	516	64
25	1,906	16,601							2,730	133	1,081	157
26	1,691	18,292	2	1	1	1	1		2,560	151	924	121
27	1,373	19,665	1				1		2,434	204	826	94
28	933	20,598			1				2,080	200	639	68
29	1,085	21,683			1		1		1,975	128	855	101
30	1,897	23,580							1,837	113	807	112
Oct 01	2,642	26,222		1	5	4	1		2,004	137	925	33
02	2,161	28,383	2	1			1		1,422	76	760	46
03	3,992	32,375	4	2	2	2	1		1,207	72	1,003	70
04	3,982	36,357	2	2	3	1	1		1,172	64	874	96
05	4,749	41,106	2	1		5	1	1	940	39	318	60
06	3,499	44,605	4		3	7		3	577	40	589	65
07-18	No counts due to flood conditions.											
19	785[c]	45,390							435	90	8	2
20	549[c]	45,939							508	39	124	28
21	341[c]	46,280							229	20	64	5
22	174[c]	46,454							37	14	12	14
23	436[c]	46,890			1				16	0	0	8
24	2,870[c]	49,760				2			113	7	2	38
25	4,235	53,995			2	1	1		83	4	0	37
26	4,229	58,224	9	2	3	1	4		222	4	5	136
27	3,433	61,657	2	1	1		2		0	37	26	110
28	1,195	62,852	2		5		3		171	11	29	117
29	193	63,045			1			1	16	9	7	14
30	160[b]	63,205							0	0	0	0
31	126	63,331							5	1	3	16
Nov 01	90[d]	63,421							0	0	0	0
02	90[d]	63,511							0	0	0	0
03	90[d]	63,601							0	0	0	0
04	90[d]	63,691							0	0	0	0
05	54	63,745							0	0	1	0
06	31	63,776							0	0	0	5
Total	63,776	63,776	34	11	30	24	18	5	50,885	3,769	22,500	4,213

[a]Chinook tag color codes: W-white, R-red, B-blue, P-pink, R/W-red/white, Y/R-yellow/red.

[b]No counts made due to high water; used mean of counts from day before (September 19) and after (September 22).

[c]Chinook counts adjusted upward by 30% (proportion of night migrants during four days immediately after) to allow for migration at night.

[d]No counts taken; used mean of counts from day before (October 31) and after (November 5).

Table 4. Results of simultaneous counts by the instructor and by regular observers at Stamp Falls fishway, 1984.

Species	Date	Instructor	Observer	% Difference
Chinook	Sep 12	62	61	- 1.6
	Oct 3	761	828	+ 8.8
Coho	Sep 12	503	603	+19.9
	Oct 3	221	190	-14.0
Jacks	Sep 12	30	32	+ 6.7
	Oct 3	18	16	-11.1
Sockeye	Sep 12	172	91	-47.1
	Oct 3	72	83	+15.3
Steelhead	Sep 12	40	29	-27.5
	Oct 3	9	7	-22.2
Total fish	Sep 12	807	816	+ 1.1
	Oct 3	1,081	1,124	+ 4.0
Overall total	Sep 12 & Oct 3	1,888	1,940	+ 2.8

counting shed. Turbid water conditions prevented fish enumeration and by afternoon the counters retreated. By mid-day of October 7, the fishway became impassible to fish due to high water velocity. This situation lasted until October 19 when the fishway was cleaned of debris and gravel which clogged its upper portion and contributed to the blockage problem. The gate was left open throughout the entire flood period (October 5 - 18), and regular counting was resumed after October 19. Some fish may have moved through the fishway early on October 7, but no estimate of their numbers was possible. From October 19 to 25 the gate was open at all times, but counting was restricted to the daylight hours. During that period, a partial velocity barrier prevented most fish from reaching the entrance to the fishway and relatively small numbers of fish moved through. On October 25, chinook began moving through the fishway in strength and counting was resumed around the clock until numbers dropped on October 29. Partial counts continued until November 6. Correction factors used to adjust for incomplete fishway counts are shown in Appendix 3.

In summary, the following overall adjustments were made in the fishway counts of chinook :

1. Observer error was estimated within ±10%.

2. No correction was made for the upstream and downstream passage of chinook over Stamp Falls outside the fishway since the two effects tended to cancel each other and no data were available to quantify this bias.

3. Incomplete fishway counts resulting from gate remaining open when counts were not conducted, were adjusted using correction factors based on the daily counts immediately before and after the day in question (Appendix 3). Some fish may have been missed during the onset of the October flood, but their numbers were assumed to be relatively small and no adjustment was made.

Given the above uncertainties, the best estimate of chinook escapement through the Stamp Falls fishway was the total adjusted fishway count corrected for observer error of ±10%, giving 63,776 ± 6,378 chinook (Table 3).

Migration timing

Daily fishway counts of chinook were plotted against time (Fig. 6). Daily counts increased from early September until early October when the flood commenced. A second migration peak was observed in late-October after flood conditions had subsided. Hatchery counts showed a major peak in late October (Fig. 6).

Table 5 chronicles the time from tagging in Alberni Inlet to sighting at three locations: at the fishway, in the river dead recovery, and at the hatchery. The mean number of days from tagging to sighting at the fishway decreased from 36 days for the first group tagged (white tags) to 12 days for the last group tagged (red/yellow). A trend in the mean time from

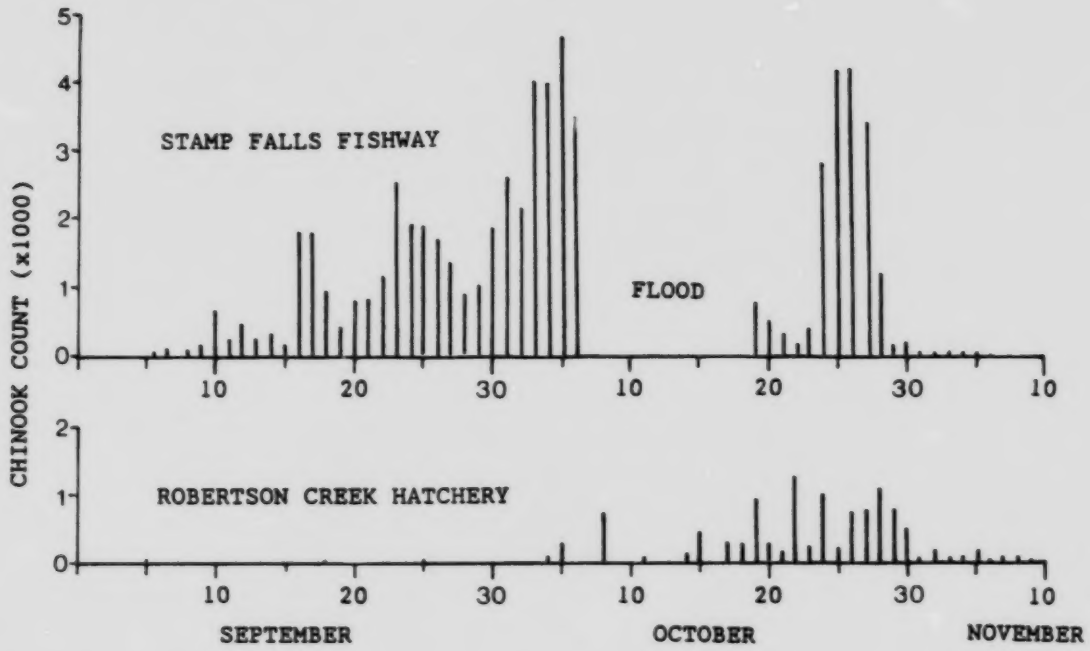

Fig. 6. Daily chinook counts at Stamp Falls fishway and Robertson Creek Hatchery, 1984.

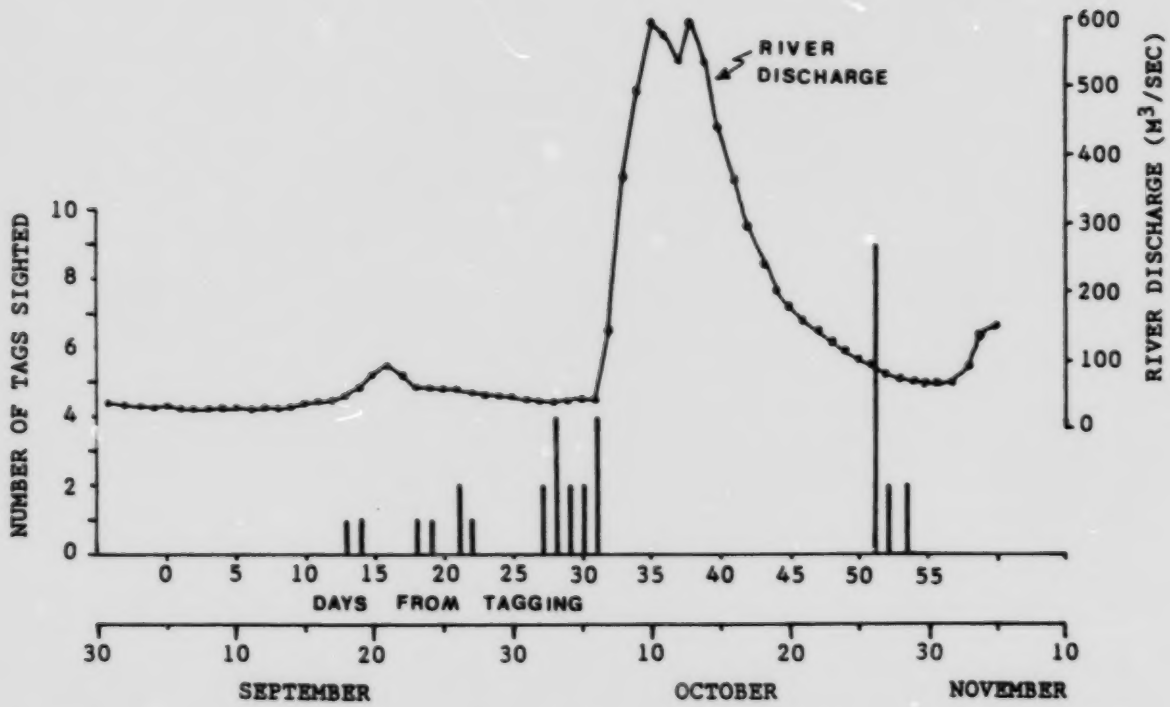

Fig. 7. Days from tagging to sighting at Stamp Falls fishway of white spaghetti tags, relative to daily river discharge, 1984.

Table 5. Julian date of chinook tagging to sighting at three locations in the Somass River system: Stamp Falls fishway, river (dead recovery), and hatchery, 1984.

	Julian date of tagging		Tag release to fishway sighting			Tag release to dead recovery			Tag release hatchery returns		
	Range	Mean Tag Date	Range	Mean	S.D.	Range	Mean	S.D.	Range	Mean	S.D.
White	248-249	248.5	13.5-53.5	35.9	13.6	50.5-54.5	51.9	2.6	44.5-54.5	49.0	4.2
Red	255-258	256.5	13.5-44.5	26.3	11.5	48.5-61.5	52.8	8.2	26.5-41.5	34.8	5.5
Blue	262	262	6-42	26.9	13.4	36-65	46.1	10.1	21-48	34.1	10.0
Pink	262	262	8-38	19.3	8.3	43-48	51.5	9.0	34-45	39.3	2.9
R/W	263	263	7-39	26.2	13.4	37-63	50.9	12.2	38-47	41.0	5.2
R/Y	272-273	272.5	6.5-31.5	12.1	10.9	37.5-45.5	41.5	5.7	28.5-37.5	32.0	3.9

tagging to recovery was not clear from the river dead pitch data or the hatchery return data. Unfortunately, the results of this experiment, involving the use of different color tags during live tagging and aimed at studying the migration timing of different segments of the run, was invalidated by the severe October flood conditions. As a result of the flood, chinook passage at Stamp Falls was blocked for 12 days during peak fish migration. Figure 7 shows the effect of the flood on the movement of white-tagged chinook through the Stamp Falls fishway; the delayed chinook required over 50 days to reach the fishway, compared to less than 30 days required by the unaffected fish.

Figure 8 shows the diel migration patterns of chinook before and after the flood, and suggests a shift to a later diel migration timing after the flood; 34.3% of chinook migrated during the hours of darkness after the flood compared to only 9.3% before the flood (Table 6).

DEAD RECOVERY

River recovery

Daily carcass recoveries in the Somass River system are shown for chinook females, males and jacks by river section (A-J) and method (walking, snorkeling, boating and diving) in Table 7. A total of 14,774 chinook were recovered between October 23 and November 26, 1984. Of these, 11,554 or 78.2% were recovered above the Stamp River Falls. Total recoveries included 38 spaghetti tags and 97 adipose marks.

Hatchery returns

Daily returns of chinook females, males and jacks to the Robertson Creek Hatchery are shown in Table 8. A total of 11,032 chinook were counted between August 23 and December 4, 1984. Of these, 37 had spaghetti tags and 90 had adipose marks. However, the actual number of heads from adipose-marked chinook received at the Tag Recovery Laboratory was 102 and this was considered the correct total; the discrepancy between the two values was attributed to recording error.

POPULATION ESTIMATES

Assumptions

In applying the Petersen-type population estimate, the number of tags available for recovery had to be adjusted downward to correct for losses due to tagging/handling mortality, tag shedding, and sport and native fisheries. Other concerns with tag recovery data included randomness of tag distribution and recovery effort, and recognition and reporting of all tags. The above concerns are addressed below.

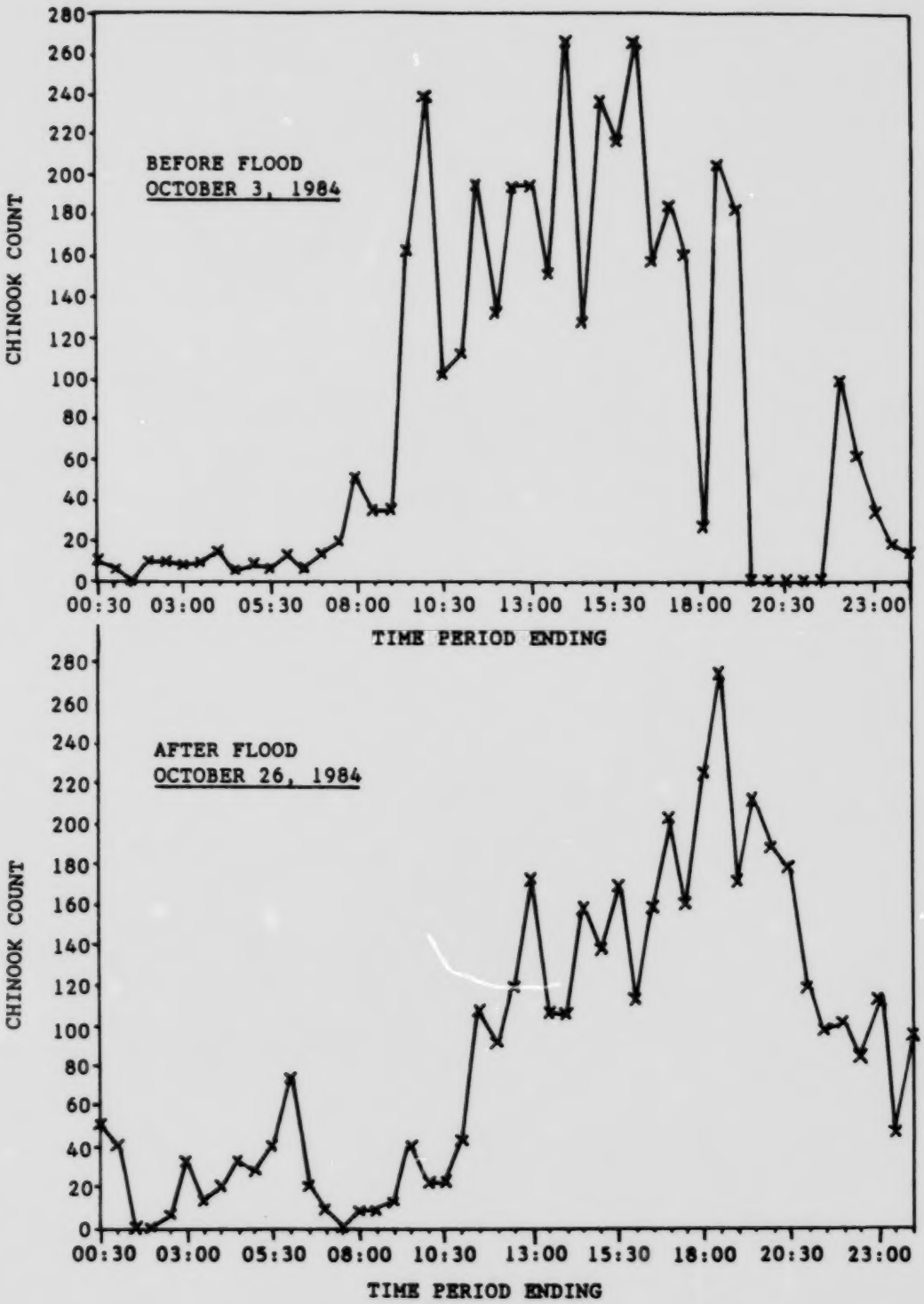

Fig. 8. Diel timing of adult chinook passage at Stamp Falls fishway before (October 3) and after (October 26) the flood, 1984.

Table 6. Counts of chinook at Stamp Falls fishway during daylight and darkness hours, 1984[a].

Date	Day counts	Dark counts	% Migrating during darkness
Sep 27	1,214	159	11.6
Oct 3	3,649	343	8.6
			Total before flood 9.4
Oct 7-18 Flood			
Oct 26	2,624	1,605	38.0
Oct 27	2,206	1,227	35.7
Oct 28	993	202	16.9
			Total after flood 34.3

[a]Daylight period was defined as 07:00 to 20:00 for September 27 and October 3, and 07:00 to 19:00 for October 26-28.

Table 7. Daily dead recoveries of chinook by river section and recovery method in the Somass River system, 1984.

Date	Recov. sect.[a]	Recov. method[b]	FEMALES Recovered No.	FEMALES Recovered #MKS	MALES Recovered No.	MALES Recovered #MKS	JACKS Recovered No.	JACKS Recovered #MKS	TOTAL Recovered No.	TOTAL Recovered #MKS	Spaghetti tag recov[c] W	R	B	P	R/W	Y/R
Oct 23	H	W	38	0	6	0	1	0	45	0	1				1	
24	A	W	41	0	26	1	1	0	68	1			1			
25	H	W	312	4	106	0	5	0	423	4			3			
26	H	W	343	8	125	1	7	0	475	9	1		1		1	
26	G	W	167	2	58	1	7	0	232	3		1				
29	C	W	417	2	196	3	127	0	740	5			1			
30	H	W	468	1	193	1	21	0	682	2	2		3			
31	A	W	144	1	239	5	16	0	399	6			1	1		
31	H	W	402	1	186	0	11	0	599	1		1	1			
Nov 02	A	W	165	1	193	0	32	0	390	1						
05	C	W	91	0	144	0	18	0	253	0			1	1	1	
05	A	W	243	2	106	0	19	0	368	2						1
06	H	W	311	0	88	0	2	0	401	0						
06	G	W	19	0	24	0	1	0	44	0						
08	C	W	33	0	0	0	0	0	33	0				1		
09	A	W	92	0	82	0	14	0	188	0					1	
09	B	W	6	0	13	0	6	0	25	0						
09	C	S	108	0	57	0	3	0	168	0		1	2			
13	A	W	76	0	35	0	8	0	119	0						1
13	B	W	110	0	71	0	26	0	207	0		1				
14	B	W	82	0	82	0	8	0	172	0						
15	C	B	34	0	52	0	16	0	102	0						
16	H	W	140	2	50	1	11	0	201	3						
16	I	W	25	0	22	0	9	0	56	0						
16	F	W	26	0	16	0	3	0	45	0						
19	B	D	974	6	675	9	88	0	1,737	15						
20	B	D	1,191	8	561	13	108	0	1,860	21					2	
20	D	W	122	0	79	0	2	0	203	0						
21	B	D	1,328	5	526	7	43	0	1,897	12			1		1	
21	A	W	80	0	38	0	6	0	124	0				1		
21	H	W	40	0	11	0	11	0	62	0						
22	E	D	1,050	5	488	3	78	0	1,616	8			2			
23	D	D	519	1	249	3	41	0	809	4						
26	F	W	18	0	13	0	0	0	31	0						
Total			9,215	49	4,810	48	749	0	14,774	97	4	4	17	4	7	2

[a]See Figure 4 for location of river sections.

[b]Recovery methods: W - walking, S - snorkeling, B - boating, D - diving.

[c]Spaghetti tag color codes: W - white, R - red, B - blue, P - pink, R/W - red/white, R/Y - red/yellow.

Table 8. Daily returns of chinook to Robertson Creek Hatchery, and incidence of adipose marks and spaghetti tags, 1984.

Date	FEMALES		MALES		JACKS		TOTAL		Spaghetti tag recovery[a]					
	Daily number	#MKS	Daily number	#MKS	Daily number	#MKS	Daily number	#MKS	W	R	B	P	R/W	Y/R
Aug 23	0	0	1	0	1	0	2	0						
28	0	0	1	0	4	0	5	0						
Sep 05	0	0	1	0	2	0	3	0						
11	0	0	1	0	13	0	14	0						
14	0	0	0	0	3	0	3	0						
18	1	0	1	0	13	0	15	0						
19	1	0	1	0	0	0	2	0						
20	0	0	0	0	4	0	4	0						
25	0	0	4	0	9	0	13	0						
30	2	0	0	0	0	0	2	0						
Oct 02	4	0	4	0	0	0	8	0						
03	0	0	0	0	2	0	2	0						
04	0	0	24	0	59	0	83	0						
05	39	1	125	1	125	4	289	6						
07	1	1	0	0	0	0	1	1						
08	196	3	281	0	232	1	709	5						
09	0	0	0	0	2	0	2	0		1	2			
10	1	0	0	0	0	0	1	0						
11	80	2	0	0	1	0	81	2						
14	66	2	50	0	2	0	118	2		1	1			
15	22	1	162	0	228	0	412	1						
16	0	0	5	0	1	0	6	0		1				
17	106	1	177	1	3	0	286	2			1			
18	119	2	95	0	7	0	221	2						
19	80	1	535	2	316	0	931	3	1	1				
20	151	0	62	0	0	0	213	0			1			
21	114	2	0	0	4	0	118	2						
22	272	1	592	0	377	5	1,241	6	1	1		1		
23	144	1	87	1	0	0	231	2						
24	258	2	377	2	344	2	979	6	1	1	1	1		
25	146	3	0	0	0	0	146	3						
26	194	3	401	2	148	1	743	6						
27	180	1	525	5	79	0	784	6				3	2	1
28	314	5	717	10	60	0	1,091	15			2	3		
29	291	3	370	0	133	0	794	3	1			1		1
30	187	3	234	4	86	1	507	8						1
31	3	0	7	0	19	1	29	1						
Nov 01	67	0	0	0	0	0	67	0						
02	159	2	11	0	24	1	194	3				1		
03	2	0	10	0	24	0	36	0						
04	44	1	10	0	22	0	76	1						
05	64	0	73	1	56	0	193	1			2		1	1
06	5	0	6	0	28	0	39	0						
07	18	0	19	1	29	0	66	1						

(Table 8 cont'd.)

Date	FEMALES Daily number	FEMALES #MKS	MALES Daily number	MALES #MKS	JACKS Daily number	JACKS #MKS	TOTAL Daily number	TOTAL #MKS	Spaghetti tag recovery[a] W	R	B	P	R/W	Y/R
Nov 08	5	0	12	0	33	0	50	0						
09	0	0	7	1	14	0	21	1						
10	3	0	1	0	7	0	11	0						
11	1	0	6	0	9	1	16	1						
12	2	0	1	0	14	0	17	0						
13	2	0	8	0	17	0	27	0						
14	4	0	9	0	16	0	29	0						
15	0	0	56	0	5	0	61	0						
16	0	0	1	0	3	0	4	0						
17	1	0	0	0	1	0	2	0						
18	0	0	1	0	1	0	2	0						
20	0	0	0	0	5	0	5	0						
21	0	0	3	0	3	0	6	0						
22	0	0	2	0	6	0	8	0						
23	0	0	2	0	0	0	2	0						
29	0	0	0	0	9	0	9	0						
30	0	0	0	0	1	0	1	0						
Dec 04	0	0	0	0	1	0	1	0						
Total	3,349	41	5,078	32	2,605	17	11,032	90[b]	4	6	10	10	3	4

[a]Spaghetti tag color codes: W - white, R - red, B - blue, P - pink, R/W - red/white, R/Y - red/yellow.

[b]Subsequent sampling of heads from adipose marked chinook showed a total of 102 and that number was accepted as the correct total.

Tagging/handling mortality: The mortality of 20 spaghetti-tagged and 20 untagged chinook after three days of holding was as follows for the two tests:

			Tagged group		Untagged group		Overall	
Test	Date in	Date out	No. dead	Mortality rate	No. dead	Mortality rate	No. dead	Mortality rate
1	Sep 19	Sep 22	2	0.10	1	0.05	3	0.08
2	Sep 29	Oct 03	10	0.50	10	0.50	21	0.53
Total			12	0.30	11	0.28	23	0.29

Although the sample sizes were too small for a statistical analysis, the results from both tests showed that mortality was similar for tagged and untagged fish (30% and 28% respectively). Therefore, it was assumed that mortality caused by tag implantation was negligible, and the observed mortality was probably the result of multiple stresses incurred during capture, transfer to holding pens and confinement for three days. Since these effects could not be separated, a direct measure of tagging mortality was not possible. However, for purposes of this report, we chose the overall mortality of 29% to represent the largely stress-induced tagging losses.

Physical tag loss: Physical tag loss was not measured in this study. Instead, a 9% tag loss rate was applied, based on a 1985 study (Lightly MS 1987). In that study, pre-spawning Somass River chinook were double-marked using spaghetti tags and single opercular punches. The dead recovery yielded 61 double-marked chinook and an additional 6 chinook bearing only an opercular punch, giving a 9% tag loss.

Tag loss to fisheries: No adjustment was made for tag loss to local sport and native fisheries during the live tagging operation due to lack of records on tag recoveries (see Discussion section).

Distribution of tags in the recovery area: Tag occurrence rates were compared for four river reaches (Table 9). The occurrence rates of individual tag colors by river section were too few to support detailed analysis. However, the overall rates of combined colors were similar between reaches (range 0.0030 - 0.0043) if the very low recovery rate in section B (0.0008) was omitted. In section B, almost all the dead recoveries were made by diving, rather than primarily by walking as in the other sections (Table 7). Further analysis suggested that effectiveness of the diving recovery was questionable (see below) so that the exclusion of section B data appears justified. The above similarity of recovery rates for different river sections suggests that tagged chinook were mixed randomly with the untagged population throughout the river.

Table 9. Recovery rates of spaghetti tags by recovery area and tag color, Somass River system, 1984[a].

Tag color	Recovery Area A		Recovery Area B		Recovery Areas C to F		Recovery Areas G to I	
	# of tags	Tag rate	# of tags	Tag rate	# of tags	Tag rate	# of tags	Tag rate
White	0	.00	0	.00	2	.0005	2	.0006
Red	0	.00	1	.0002	1	.0003	2	.0006
Blue	2	.0012	1	.0002	6	.0015	8	.0025
Pink	2	.0012	0	.00	2	.0005	0	.00
Red/white	1	.0006	3	.0005	1	.0003	2	.0006
Red/yellow	2	.0012	0	.00	0	.00	0	.00
Overall	7	.0042	5	.0008	12	.0030	14	.0043
No. fish examined	1,656	-	5,898	-	4,000	-	3,220	-

[a]See Figure 4 for location of river sections.

Non-detection/non-reporting of tags using different recovery methods: During tag recovery it was important that all tags be recognized and reported. Assuming no bias in tag distribution, tag recovery rates should be similar regardless of the method used. If the rates differ significantly, then some methods are probably more effective in discovering tags than others. The recovery methods fell into three main catagories:

1. fishway counts where fish could not be handled and viewing conditions varied,

2. streambank dead recovery and hatchery recovery where each fish was handled and a thorough examination was possible, and

3. dead recovery by diving where each fish was handled, but a complete examination was sometimes difficult.

Tag occurrence rates by different recovery methods are shown in Table 10. Generally, blue tags were encountered most frequently in the fishway, river, and hatchery. This was expected since blue was the dominant color used in live tagging (42% of all tags applied, Table 2). In comparing recovery methods, all tag colors were pooled to increase sample size. Tag occurrence rates using different recovery methods were compared by applying the arcsine transformation to the rates, and using a t-test (Sokal and Rohlf 1969). Tag occurrence rates ranged from a low of 0.00076 for diving recoveries to a high of 0.00467 for streambank recoveries (Table 10), with the difference between the two rates being highly significant ($p<0.001$). The fishway and hatchery recoveries showed intermediate tag occurrence rates.

The very low recovery rate observed for diving could be the result of two factors. The first is that the fish recovered by this method represent a different segment of the population, one not exposed to tagging. However, this explanation is not supported by the normal rate of recovery observed in the section immediately above section B where most of the dead fish in question must have originated (Table 7). The second possible explanation is that the tags were missed by divers examining the carcasses. The fish were heavily fungused and this may have obscured the tag. Another factor could be tag drop-out (rot-out). This is supported by the fact that of the six tags found by divers, two were lying loose on the bottom. Due to possible significant non-detection of tags, the dead recovery results from diving were not used in the subsequent population estimates.

The tag occurrence rate observed at the fishway (.00202) was also significantly lower ($p<.01$) than that observed in the river dead recovery (0.00467, excluding diving) and at the hatchery (0.00336). Since the tagged fish recovered above the falls, in the river and at the hatchery should have passed through the fishway, the above difference may be explained by non-detection of tags at the fishway. Due to possible significant non-detection of tags, fishway data were not used in the Petersen population estimate.

General non-detection/non-reporting of tags: Another important factor to consider was a general non-detection or non-reporting of tags in the dead recovery and at the hatchery. The experiment at the Big Qualicum River spawning channel showed that of the 200 tagged chum carcasses released there on November 28, 1984, only 182 tags were turned in by December 5, with the

Table 10. Recovery rates of spaghetti tags by location/method and tag color, Somass River system, 1984.

	Stamp Falls fishway[a]		Dead recovery (total)		Dead recovery (diving only)[b]		Dead recovery (without diving)[c,d]		Hatchery returns[c]	
Tag color	# of tags	Tag rate	# of tags	Tag rate	# of tags	Tag rate	# of tags	Tag rate	# of tags	Tag rate
White	34	.00056	4	.00027	0	.00	4	.00058	4	.00036
Red	11	.00018	4	.00027	0	.00	4	.00058	6	.00054
Blue	30	.00050	17	.00115	3	.0038	14	.00204	10	.00091
Pink	24	.00040	4	.00027	0	.00	4	.00058	10	.00091
Red/white	18	.00030	7	.00047	3	.0038	4	.00058	3	.00027
Red/yellow	5	.00008	2	.00014	0	.001	2	.00029	4	.00036
Overall	122	.00202	38	.00257	6	.00076	32	.00467	37	.00336
Sample size	60,476[e]	-	14,774	-	7,919	-	6,855	-	11,032	-

[a]Fish not handled, variable viewing conditions.

[b]Fish handled but thorough examination difficult at times.

[c]Fish handled and thorough examination possible.

[d]Mostly streambed recovery by walking.

[e]Actual unadjusted fishway counts.

majority found in the first three days. This gave a tag recovery rate of 0.91. Since every fish was handled, the missing tags were the result of either tag loss, non-detection of tag during handling, or non-reporting of tag. The possibility of tag loss in this situation was slight, so the missing tags were probably the result of some combination of non-detection and non-reporting. As a result of the above findings, the Somass River tag recoveries from the dead recovery and the hatchery returns were adjusted upward by a factor of 10% to compensate for tag non-detection and non-reporting.

Calculations

Population of chinook salmon entering the spawning grounds of the Somass River system was estimated using the river dead recoveries (excluding diving recoveries), the hatchery returns and the two methods combined, and applying the adjusted Petersen formula (see Methods section):

$$N = \frac{(M + 1)(C + 1)}{(R + 1)}$$

As mentioned above, fishway counts and diving counts could not be used due to apparent significant non-detection of tags. Numbers of fish tagged (M), carcasses examined (C), tagged fish recovered (R) and the Petersen estimates (N) are shown for each recovery method in Table 11. The number of tags available for recovery (M) was adjusted downward by 38% to correct for tagging mortality of 29% and tag shedding of 9% (see sections above). The numbers of tags recovered in the river and at the hatchery (R) were adjusted upward by 10% to correct for tag non-detection and non-reporting.

Based on the results of the tagging in Alberni Inlet and the combined hatchery and dead recoveries, the population of chinook present at the head of Alberni Inlet between September 4 and September 29 was estimated at 100,000 fish with lower and upper 95% confidence limits of 80,000 and 125,000 respectively (Table 11). By comparison, the river dead recovery data (excluding diving) gave a lower population estimate of 81,000 fish, while the hatchery return data gave a higher estimate of 115,000 fish, with the 95% confidence limits of these two estimates overlapping considerably (Table 11).

In order to determine the actual river spawning population, the estimated population of 100,000 chinook present at the head of Alberni Inlet during tagging, was adjusted downward to correct for the fisheries catch component (sport and native) subsequent to live tagging, and for the hatchery component. These adjustments are summarized in Table 12 and are reviewed below.

Fisheries catch component: An estimated 28,000 chinook were captured in the Alberni Inlet sport fishery conducted during August and September (Fig. 9, DFO unpubl. creel survey data). Peak catches occurred on the Labour Day weekend, just prior to the start of tagging, with about 13,000 chinook captured after the start of tagging. This latter value was subtracted from the spaghetti tag population estimate.

Table 11. Petersen population estimates using tag recoveries in the river and at the hatchery, Somass River system, 1984.[a]

Parameter	River		Hatchery		River and hatchery
	Actual data	Corrected data	Actual data	Corrected data	Corrected data
Tags applied (M)	704	436[b]	704	436[b]	436[b]
Fish examined (C)	6,855[c]	6,855[c]	11,032	11,032	17,887
Tags recovered (R)	32[c]	36[d]	37	41[d]	77
Recovery rate	-	0.0053	-	0.0037	0.0043
Populations estimate (N)	-	80,975	-	114,796	100,219
95% C.L.	-	58,978 115,234	-	85,154 154,434	80,422 124,873

[a]Used formula: $N = \frac{(M + 1)(C + 1)}{(R + 1)}$

[b]Adjusted downward by 38% to correct for tagging mortality of 29% and tag shedding of 9%.

[c]Diving recoveries not included.

[d]Adjusted upward by 10% to correct for tag non-detection and non-reporting.

Table 12. Catch and escapement components in the chinook population present at the head of Alberni Inlet during live tagging, 1984.

Location	Numbers of chinook[a]	95% C.L.	Reference
Alberni Harbour sport fishery	13,000	5,610 - 20,390	DFO (unpubl. data)
River sport fishery	3,000	2,614 - 3,386	Anon. (MS 1985)
Indian food fishery	12,000	2,471 - 21,529	Anon. (MS 1984) provided base data
Illegal river fishery	5,000		
Total	33,000		
Hatchery escapement	11,000		Table 8
River escapement	56,000		Footnote "b"
Total population	100,000	80,422 -124,873	Table 11

[a]All numbers rounded to nearest one thousand.

[b]River escapement obtained by subtracting hatchery and catch components from total population estimate i.e. 100,000-(33,000 + 11,000) = 56,000 chinook.

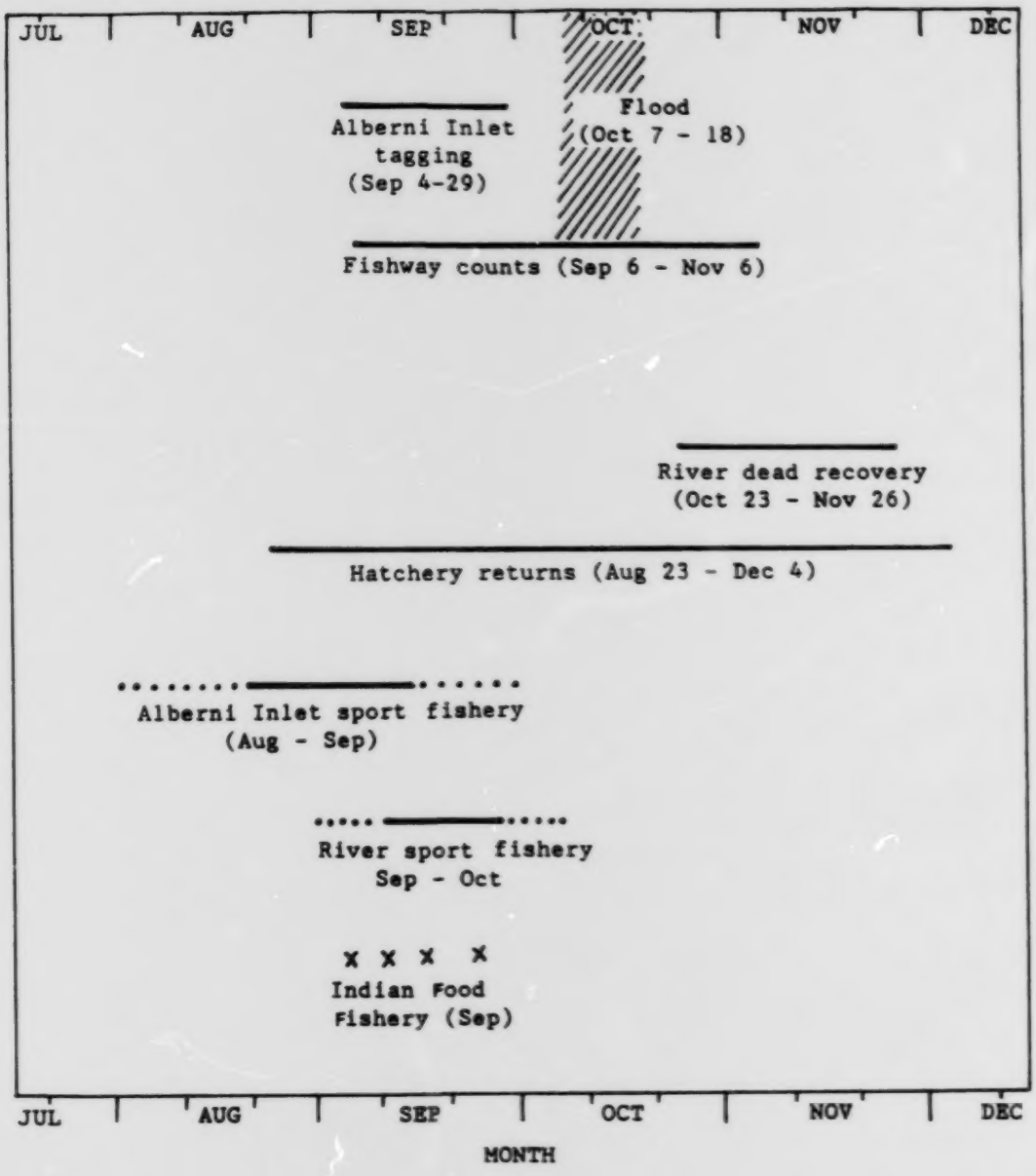

Fig. 9. Relative timing of chinook enumeration programs and fishing activities in the Somass River system, 1984.

An estimated 3,300 chinook were captured in the river sport fishery conducted during September and October (Fig. 9, Anon. MS 1985). This is probably an underestimate since by September 20 when the creel survey began, 7,500 chinook (12% of the run) had already passed through the Stamp Falls fishway and many anglers were observed on the river prior to this date. In addition, chinook catchability is generally higher early in the run.

An estimated 15,000 chinook were gillnetted in the Somass River Indian food fishery conducted on four occasions: September 4-5, 9-10, 16-17, and 23-24 (Fig. 9, catch estimate based on Anon. MS 1984). The initial opening coincided with the first day of tagging on September 4 and yielded 3,000 chinook. Although the lower boundary of the native fishery coincided roughly with the upper limit of the tagging area (Fig. 4), it is probable that very few chinook, included in the population estimate for Alberni Harbour, were exposed to this initial fishery. Consequently, only the 12,000 chinook caught in the subsequent Indian food fisheries were subtracted from the spaghetti tag population estimate.

In addition to the above legal and measurable catches, some illegal fishing activity also occurred. Fishery Officers estimated that between 1,000 and 2,000 chinook were being removed annually in the Somass River system through illegal net fishing (B. Kanester and E. Lochbaum, pers. comm.). An additional estimated 3,000 chinook were taken in 1984 in illegal sport fishing. This activity was concentrated in a large pool below the Stamp Falls where an average of 10 anglers were seen on any one occasion. The above illegal sport catch figure of 3,000 was based on an assumed angler turnover of three times each day and an hourly catch rate similar to that observed for legal anglers. Based on the above assumptions, an estimated 5,000 chinook were removed illegally from the Somass River system in 1984.

Summing up the various catch components, an estimated 33,000 chinook were captured in the sport and Indian food fisheries after live tagging in the Alberni Harbour; another 11,000 chinook escaped to the hatchery. By subtracting the sum of hatchery and catch components (44,000 fish) from the overall population estimate of 100,000 chinook, the river escapement of 56,000 fish was obtained. The river population was further subdivided into escapements above and below the Stamp River Falls as follows:

River escapement above falls = Fishway counts - Hatchery returns

or 64,000 - 11,000 = 53,000 chinook

River escapement below falls = Total river escapement - River escapement above falls

or 56,000 - 53,000 = 3,000

INCIDENCE OF ADIPOSE MARKS AND CWT TAGS

A total of 97 adipose marks were identified in the river dead recovery (Table 7), of which 27 heads were available for CWT analysis (see

Table 13 for explanation). A total of 102 adipose marks were identified in the Robertson Creek Hatchery returns (Table 8), and all heads were available for CWT analysis. The deciphered codes are given in Table 13.

The recoveries of adipose marked fish from various locations in or near the Somass system are shown in Table 14. Recovery rate was highest in the harbour tagging (0.0256) and lowest in the Indian food fishery (0.0012). The differences between the various recovery rates were tested using the t-test as described in Sokal and Rohlf (1969), and were found to be singificant in most cases (Table 15).

The occurrence rates of adipose marks in male and female carcasses for the three recovery methods (walking, diving and hatchery returns) are shown in Table 16. In the dead recovery, (walking and diving), all rates were similar except for a significantly higher rate for males recovered by diving ($p<.05$). This difference is also apparent in Table 17 which shows the recovery rates of adipose marked fish for the different river sections. If one ignores those sections with few recoveries, the only major difference among the dead recovery rates is for males from section B where a relatively high mark recovery rate of 0.0131 was observed. In section B, the proportion of males recovered (37.4%) was the same as in the overall dead recovery (37.8%, Table 7), but unlike other sections, 93.2% of the total recoveries were made by diving. The situation was reversed in the hatchery where the adipose mark rate was much higher for females than males ($p<.01$) (Table 16).

The adipose mark recovery rates for the river and the hatchery were applied to the respective estimated escapements for the two locations:

Location	Adipose mark recovery rate (Table 14)	Estimated escapement (Table 12)	Total adipose marks
River	0.0062	56,000	347
Hatchery	0.0092	11,000	101
Total	-	77,000	448

As seen from above, an estimated 347 and 101 adipose marked chinook escaped into the river and hatchery respectively.

CONTRIBUTION OF HATCHERY AND NATURAL PRODUCTION TO NATURALLY SPAWNING ESCAPEMENT

The separation of the naturally spawning river escapement into hatchery-produced and wild components requires the knowledge of the adipose-coded mark rate in the hatchery component of the river escapement. Two approaches were taken. In the first, it was assumed that the mark rate at release in any hatchery-produced group of fish remained unchanged throughout the fish lifespan, i.e. mortality of marked and unmarked fish remained the same. The estimated escapement of any CWT code, or combination

Table 13. Deciphered codes for adipose-marked chinook recovered in the Somass River system and Robertson Creek Hatchery, 1984.

Brood year	Tag code	Male	Female	Total
		River Dead Recovery		
1981	02/24/05	0	3	3
1980	02/16/61	1	6	7
1980	02/19/17	0	1	1
1980	02/19/36	0	1	1
1979	02/17/15	0	2	2
1979	02/18/06	0	1	1
1979	02/18/27	1	2	3
	Lost pin	1	2	3
	No pin	4	2	6
Total		7	20	27[a]
Total with pin		2	16	18
		Hatchery Returns		
1982	08/22/22	1	0	1
1982	08/22/23	1	0	1
1982	08/22/24	1	0	1
1982	08/22/25	2	0	2
1982	08/22/26	1	0	1
1982	02/25/41	7	0	7
1981	02/22/02	4	0	4
1981	02/23/54	2	0	2
1981	02/23/55	1	0	1
1981	02/23/56	3	0	3
1981	02/24/05	12	1	13
1980	02/16/61	7	21	28
1980	02/19/36	3	3	6
1980	02/19/37	0	1	1
1979	02/18/27	0	6	6
1979	02/18/29	1	6	7
	No pin/Lost pin	5	13	18[b]
Total		51	51	102
Total with pin		46	38	84

[a]Additional 60 adipose-marked chinook were recorded during diving but their heads not retained for CWT analysis, and 10 heads were missing from carcasses or were lost during the recovery program, giving a total of 97 marked chinook (Table 7).

[b]Of these, two pins were lost.

Table 14. Adipose marks recovered and mark rates observed at different recovery locations in Alberni Inlet and Somass River system, 1984.

Recovery location	#Chinook examined	Adipose marks	Mark rate	Source of data
Harbour tagging	704	18	.0256	Table 2
River sport fishery	222	5	.0225	Anon. (MS 1985)
Terminal net	9,847	182	.0185	DFO, Head Recovery Program
Hatchery	11,032	102	.0092	Table 8
Inlet sport fishery	1,207	9	.0075	DFO, unpubl. data
Dead recovery	14,774	91[a]	.0062	Table 7
Indian food fishery	845	1	.0012	Anon. (MS 1984)

[a]Adjusted downward from 97 marks to correct for possible rotted adipose fins interpreted as marks (see Discussion section).

Table 15. Comparison of adipose mark rates observed at different recovery locations in Alberni Inlet and Somass River system, 1984 (mark rate per location is shown in parenthesis).

Recovery location	Compared to	Difference[a]
Harbour tagging (.0256)	Terminal net fishery (.0185)	NS[b]
River sport fishery (.0225)	Hatchery (.0092)	$p<.05$
River sport fishery (.0225)	Dead recovery (.0062)	$p<.01$
Terminal net fishery (.0185)	Inlet sport fishery (.0075)	$p\leq.01$
Hatchery (.0092)	Dead recovery (.0062)	$p<.05$
Hatchery (.0092)	Indian food fishery (.0012)	$p<.05$
Inlet sport fishery (.0075)	Harbour tagging (.0256)	$p\leq.01$
Dead recovery (.0062)	Indian food fishery (.0012)	NS
Indian food fishery (.0012)	River sport fishery (.0225)	$p<.001$

[a]Differences between recovery rates were tested using the t-test as described in Sokal and Rohlf (1969).

[b]NS - not significant.

Table 16. Adipose mark rates observed in walking and diving dead recoveries, and at the hatchery, Somass River system, 1984[a].

Method of recovery	Females recovered			Males recovered			Total recovered		
	# Sampled	# Mkd	Mark rate	# Sampled	# Mkd	Mark rate	# Sampled	# Mkd	Mark rate
Walking[b]	4,153	24	.0058	2,702	13	.0048	6,855	37	.0055
Diving	5,062	25	.0049	2,857	35	.0123	7,919	60	.0075
Walking and Diving	-	-	-	-	-	-	14,774	97[c]	.0066
Hatchery returns	3,349	51	.0152	7,683	51	.0066	11,032	102	.0092

[a]Dead recovery data from Table 7; hatchery returns from Table 8.
[b]Includes snorkeling and boating.
[c]Not corrected for possible rotted adipose fins (see Discussion section).

Table 17. Adipose mark rates for females and males observed in the dead recovery by river section, Somass River system, 1984.

River section[a]	Females recovered			Males recovered			Total recovered		
	# Sampled	# Mkd	Mark rate	# Sampled	# Mkd	Mark rate	# Sampled	# Mkd	Mark rate
A	841	4	.0048	815	6	.0074	1,656	10	.0060
B	3,691	19	.0051	2,207	29	.0131	5,898	48	.0081
C	683	2	.0029	613	3	.0049	1,296	5	.0039
D	641	1	.0016	371	3	.0081	1,012	4	.0040
E	1,050	5	.0048	566	3	.0053	1,616	8	.0050
F	44	0	.00	32	0	.00	31	0	.00
G	186	2	.0108	90	1	.0111	276	3	.0109
H	2,054	16	.0078	834	3	.0036	2,888	19	.0066
I	25	0	.00	31	0	.00	56	0	.00
Total	9,215	49	.0053	5,559	48	.0086	14,774	97	.0066

[a]See Figure 4 for location of river sections.

of codes from the same brood year could then be expanded by the mark rate at release for that code or codes. This should yield the hatchery contribution to the naturally spawning escapement of the fish represented by the code or codes examined. That is:

$$N_j = \frac{t_j}{r_j}$$

where N = hatchery contribution
t = escapement of CWT marks
r = release rate of CWT marks
j = CWT code or a combination of codes from a brood

The escapement of marks by brood year/age class in the total naturally spawning population was estimated as follows. The age composition of the 18 decoded marks from the dead recovery (Table 13) was applied to the total number of marks from the dead recovery (91) to estimate the age breakdown of marks. These estimates and the age breakdown of the dead recovery sample (14,774) provided the mark rate for each age class in the escapement. This mark rate at age was then applied to the respective age groups in the estimated natural spawning population of 56,000 fish to estimate the total escapement of marks in the river by brood year/age group.

In order to estimate the hatchery component in the naturally spawning population, the mark rate at release for each brood year was applied to the estimated number of marks at each age in the spawning population. These calculations are shown in Table 18. The total hatchery contribution to the natural river escapement was estimated at 14,882 chinook and the natural contribution, obtained by subtraction, was estimated at 41,118.

In the second approach used to estimate the hatchery component in the river escapement, it was assumed that only the hatchery-produced fish entered the hatchery and that the mark rate observed there was the actual mark rate for hatchery-produced fish throughout the system. Since no age data were available for the unmarked fish returning to the hatchery, it was impossible to estimate hatchery and wild contribution by age class, but an overall estimate was possible using this assumption.

The dead recovery mark rate of 0.0062 (Table 14) was applied to the river escapement estimate of 56,000 giving 347 marks. These marks were then expanded using the hatchery mark rate of 0.0092 (Table 14), to give an estimate of 37,717 hatchery-produced chinook in the river escapement. Subtracting this from the total river spawning population of 56,000 gave an estimate of 18,283 naturally produced fish.

Thus, the two approaches used above gave very different estimates of the wild component in the naturally spawning river population, 41,118 fish using the mark rate at release and 18,283 using the mark rate at recovery.

Table 18. Hatchery contribution in 1984 to the naturally spawning river escapement in the Somass River system, as estimated by mark rates at release; wild production was estimated by subtraction (numbers at the top indicate column numbers).

1	2	3	4	5	6	7	8	9	10	11	12
		Decoded CWT dead recovery marks[a]			Total dead recovery sample[c]		Estimated river escapement			River Escapement	
Brood year	Age	Number	%	Total dead recovery marks/age[b]	Number	Mark rate[d]	Number[e]	Marks[f]	Mark rate at release[g]	Estimated hatchery contribution[h]	Estimated natural contribution[i]
1982	2	0	0	0	662	.0000	3,419	0	.0362	0	3,419
1981	3	3	16.7	15	1,534	.0098	7,341	72	.0161	4,472	2,869
1980	4	9	50.0	46	10,378	.0044	37,885	167	.0226	7,389	30,496
1979	5	6	33.3	30	2,200	.0136	7,355	100	.0331	3,021	4,334
Total	-	18	100	91	14,774	.0062	56,000	339	-	14,882	41,118

[a]From Table 13.

[b]Total from Table 14; age composition from column 4.

[c]Total sample of 14,774 fish (Table 7) subdivided into age groups by applying separately to males and females the age composition data, based on scale samples from dead recovery (Appendix 5).

[d]Column 5 ÷ column 6.

[e]Total river escapement of 56,000 fish (Table 12) subdivided into age groups (see footnote "c" above), but with the sex ratio based on combined data from river dead recovery and hatchery returns (Appendix 5).

[f]Column 8 x column 7.

[g]From Robertson Creek Hatchery records.

[h]Column 9 ÷ column 10.

[i]Column 8 minus column 11.

BIOLOGICAL SAMPLING

Sex composition

Sex composition of chinook recovered in the river and at the hatchery is shown in Table 19. Females constituted 62.4% of the total river dead recoveries but only 30.4% of the hatchery returns. The combined river dead recoveries and hatchery returns showed an overall sex composition of 48.7% females and 51.3% males.

Age composition

Of the 325 fish sampled for scales during the river dead recovery, 238 provided age data as follows: age two - 5%, age three - 11%, age four - 69% and age five-14% (Table 20). Males showed a younger age composition than females, with 12% of the males and 0% of the females in the age two category. Scale readings indicated that all fish were sub-1 or ocean type.

Spawning success

A total of 1,839 and 2,291 females were recovered in the river above and below the Stamp Falls respectively, and assessed for spawning success (Table 21). The overall pre-spawning mortality was 46.7% but the proportion of unspawned females was much higher below the falls (68.8%) than above (19.1%).

DISCUSSION

FISHWAY COUNTS

Sources of error

Observer error in chinook counts at the fishway was less than ± 10%. This is within the range expected for such methods. Becker (1962) found that the range of variation among individual observers doing simultaneous counts of sockeye from a tower on the Kuichak River was 18-22%, but when the results of 32 such tests were totalled, the difference amounted to only 1%. International Pacific Salmon Fisheries Commission biologists consider their tower counts to be within ± 15% to ± 30% of actual escapement, while Alaskan biologists feel their tower counts are accurate to within ± 5% to ± 10% (Cousens et al. 1982).

The evidence for upstream fish passage over Stamp Falls is indirect and the success rate is difficult to quantify. Anglers (pers. comm.) have reported the presence of large chinook spawners above the falls during a

Table 19. Sex composition of chinook recovered in the river and at the hatchery, Somass River system, 1984[a].

Location	Females		Males	
	Number	%	Number	%
River above Stamp Falls	6,950	60.2	4,604	39.8
River below Stamp Falls	2,265	70.3	955	29.7
Total river	9,215	62.4	5,559[b]	37.6
Hatchery	3,349	30.4	7,683[c]	69.6
River and hatchery	12,564	48.7	13,242	51.3

[a]River dead recovery data from Table 7 and hatchery returns from Table 8.

[b]Includes 749 jacks (5.1% of total).

[c]Includes 2,605 jacks (23.6% of total).

Table 20. Age composition of chinook females and males from dead recovery samples, Somass River system, 1984[a].

Date	Recovery section[b]	Number of females at age				Number of males at age				Number of males and females at age			
		2	4	4	5	2	3	4	5	2	3	4	5
Nov 02	A	0	1	4	0	1	2	0	0	1	3	4	0
05	A	0	1	11	2	1	3	7	0	1	4	18	2
06	H	0	1	15	5	0	1	6	1	0	2	21	6
08	C	0	0	8	2	2	2	5	1	2	2	13	3
09	A	0	0	0	0	1	1	0	1	1	1	0	1
13	A	0	0	4	2	0	0	8	2	0	0	12	4
13	B	0	0	7	2	2	2	5	1	2	2	12	3
16	H	0	0	27	4	3	3	11	1	3	3	38	5
16	F	0	0	3	1	0	0	0	0	0	0	3	1
18	G	0	0	3	1	0	0	0	0	0	0	3	1
19	C	0	0	6	1	0	0	0	0	0	0	6	1
19	A	0	0	2	0	0	0	0	0	0	0	2	0
20	C	0	1	8	1	0	2	10	0	0	3	18	1
21	A	0	0	4	2	1	3	4	0	1	3	8	2
21	B	0	0	4	4	1	4	3	0	1	4	7	4
Total		0	4	106	27	12	23	59	7	12	27	165	34
		(Total females = 137)				(Total males = 101)				(Total = 238)			
% Age Composition													
Females		0	2.9	77.4	19.7	-	-	-	-	-	-	-	-
Males		-	-	-	-	11.9	22.8	58.4	6.9	-	-	-	-
Total		-	-	-	-	-	-	-	-	5.0	11.3	69.3	14.3

[a]Scale readings showed that all fish were ocean type (i.e., sub-1).

[b]See Figure 4 for location of recovery sections.

Table 21. Spawning success of chinook females recovered above and below the Stamp Falls, 1984.

	Recoveries above Stamp Falls				Recoveries below Stamp Falls			
Date	Recov. section[a]	Number recov.	Number unspawned	Percent unspawned	Recov. section[a]	Number recov.	Number unspawned	Percent unspawned
Oct 23	A	41	29	70.7	H	38	35	92.1
24								
25					H	312	208	66.7
26				6	H	343	244	71.1
26					G	167	107	64.1
29	C	417	40	9.6				
30					H	468	371	79.3
31	A	141	32	22.7				
31					H	402	286	71.1
Nov 02	A	165	40	24.2				
05	C	91	35	38.5				
05	A	243	25	10.3				
06					H	311	217	69.8
06					G	19	14	73.7
08	C	33	33	100.0				
09	A	92	21	22.8				
09	B	6	1	16.7				
09	C	108	25	23.2				
13	A	76	8	10.5				
13	B	10	18	16.4				
14	B	82	21	25.6				
15	C	34	14	41.2				
16					H	140	84	60.0
16					I	25	5	20.0
16					F	26	0	0
20	D	119	0	0				
21	A	76	5	6.6				
21					H	40	5	12.5
26	F	5	5	100.0				
Total		1,839	352	19.1		2,291	1,576	68.8

[a]See Figure 4 for location of river sections.

period when fish passage through the fishway was blocked by an electronic tunnel counter. Also, the present authors observed chinook attempting to ascend the falls, and in rare cases the fish appeared to succeed.

The only evidence available on multiple passage at the fishway was an observation during the 1984 program when a single chinook which received a double tag color code of white and blue was seen twice passing through the fishway. This one instance does not provide any indication of the frequency of multiple passage, but suggests that it may occur. Future enumeration at the fishway should investigate this problem by tagging chinook at the Stamp Falls.

Migration timing

In 1972 and 1973, 973 and 1,103 chinook respectively were counted through the Stamp Falls fishway (DFO, unpubl. data). In both years, the median and peak days of migration were October 21. These data could not be compared with the 1984 migration timing due to disruption of that year's fishway counts by flood conditions.

The apparent shift in 1984 to later diel migration timing after the flood may be the result of several factors: seasonal changes in water temperature and daylength, behavioural differences between the earlier and later migrating segments of the run, and different behavioural responses by chinook to a prolonged delay in their upstream migration. Further studies are required to clarify the diel migration pattern of the Somass chinook.

POPULATION ESTIMATES

Not all the assumptions involved in the Petersen-type population estimate were tested adequately in the 1984 escapement program. If the tagged fish migrated out of the study area as a result of the tagging procedure, then the tag recovery rate would be biased. This possibility was not assessed in the program. However, it is likely that during the October flood which preceded the river dead recovery program, a proportion of chinook was washed out of the river and became unavailable for recovery. The tagged fish could have been particularly susceptible to the washout if they were weaker and dying prematurely compared to the untagged fish. This bias could not be assessed but would result in overestimation of the escapement.

During live tagging in Alberni Inlet between September 4 and 29, a portion of tags may have been removed in the Alberni Inlet sport fishery conducted during August and September and the river sport fishery conducted during September and October. However, no record of recovered tags was available from the sport creel surveys monitoring these fisheries (DFO, unpubl. data; Anon. MS 1985). Additional tags may have been removed in the native fishery occuring in the Somass River system primarily during September. However, only one spaghetti tag was recovered during sampling of the native catch that year (Anon. MS 1984). Given the lack of tag recovery

data in the local fisheries, no correction factor was applied for this possibility. Also, it was assumed that chinook vulnerability to fisheries did not increase as a result of tagging.

The tagging mortality of 29% assessed by holding fish in pens for three days following capture and tagging, did not provide satisfactory results. The sample size was relatively small and the fish were subjected to a variety of stresses, the effects of which could not be isolated.

The tag loss rate was not measured in 1984. Instead, the rate of 9% obtained in the 1985 Somass chinook study was applied to the 1984 population estimate. Tag loss rates were assessed for several chinook key streams in the Fraser River during 1984 and 1985 (PSARC MS 1987). Fish were captured in beach seines and gillnets in the river, double-marked with spaghetti tags and opercular punches, and subsequently recovered in a dead pitch. The results were as follows:

Key stream	Year	Tag loss rate (%)	
		Male	Female
Shuswap	1984	1.0	-
	1985	1.0	3.0
Harrison	1984	24.0	14.0
	1985	6.0	3.0
Kalum	1985	47.0	12.0

As seen from above, tag loss rates ranged from 1% to 47%, were different for males and females, and varied with site and year. Tag loss rate was also related to tag quality and tying procedure as indicated by the Harrison system data where the use of newer tags and tighter knots in 1985 resulted in a considerably lower tag loss rate compared to 1984.

In another study, coho from the Cowichan estuary were double-marked using Floy spaghetti tags and Petersen discs, and upon recovery showed a spaghetti tag loss rate of 25% (Lister et al. 1981). Johnston et al. (1986) double-marked pink salmon at the mouth of Keogh River using spaghetti tags and adipose clips, and found a tag loss rate of 5%. Vernon et al. (1964) tagged pink salmon at three locations each progressively closer to the spawning grounds: in Glendale Cove, in the stream below the fence and at the fence. Unpublished data from this study showed that 29% of cove-tagged fish and 39% of stream-tagged fish did not reach the fence (Simpson 1984). These figures probably represent a combination of tagging mortality and physical tag loss; migration of tagged fish out of the tagging area was also possible.

Because of the considerable variation in the rate of tag shedding (see above), it is strongly recommended that any future tagging studies should include secondary marks to evaluate this problem.

An experiment in the Big Qualicum River spawning channel using chum carcasses showed a general non-detection or non-reporting of tags of 10%. Ward (1959) also reported that up to 10% of tagged Fraser River pink salmon were missed during the first examination of spawning grounds.

The mark-recapture estimates require that a representative sample of the population be tagged, that tagged fish become randomly mixed with the untagged population, and that a representative sample of the population be examined for marks (Cousens et al. 1982). Daily numbers of chinook tagged in the Alberni Harbour during September ranged from three to 295 (Fig. 5) and large seine catches were released to reduce fish stress during tagging. This technique, combined with a certain amount of selectivity by net gear for fish size and sex, and possible temporal segregation of prespawning chinook by size and sex, probably resulted in less than representative subsampling of the population during tagging. This bias, however, was not assessed.

Carcass recovery may be highly selective for fish size and sex, favoring the recovery of larger fish and of females; the presence of a tag may also affect recovery success (PSARC MS 1987). Such selectivity would further bias the population estimates but the magnitude of this problem is unknown. Different types of biases were involved in determining tagged: untagged ratios using river dead recoveries compared to hatchery returns. These differences were responsible for the different population estimates obtained using the two methods (81,000 chinook using river dead recovery data and 115,000 chinook using hatchery returns).

The various problems associated with the mark-recapture population estimates, as they apply to the Chinook Key Stream Program in British Columbia, were reviewed by PSARC (MS 1987). Those authors found that the precision of chinook population estimates, based on Petersen mark-recapture method, varied from ±4% to ±32% with an average of ±17% over two years. Simpson (1984) reviewed 25 tests made of the accuracy of mark-recapture escapement estimates. These tests showed that the method almost always overestimated the true number, the geometric mean being a 17.5% overestimate. The precision, however, was poor with the 95% confidence limits of the mean error ranging from 5.4% to 57.0%.

Only about 15,000 chinook carcasses were examined during the 1984 river dead recovery; this is only 27% of the estimated river escapement of 56,000 fish. Shardlow et al. (1986) conducted an intensive dead recovery on chinook in the Campbell River system during the fall of 1984. The recovery rate for this relatively short and flow-controlled water course was 30%. Studies on the Big Qualicum River, which is also flow-controlled and has less than a tenth of the average flow of the Somass River system, showed that observers counted an average of 28%, 43%, and 63% of the total chinook spawners during walking, rafting, and swimming surveys respectively (Shardlow et al. 1987). The above studies suggest that the recovery rate on the Somass system was probably even lower, particularly due to the high flushing rate during the October flood which likely resulted in fish being washed out into areas inaccessible for counting or completely swept out of the system. Assuming a dead recovery rate of 20% for the Somass system, the approximately 15,000 carcasses dead-pitched in 1984, would represent a river escapement of 75,000 which is in general agreement with the Petersen estimate of 56,000 chinook.

Only 3,000 chinook were estimated to have spawned in the river below Stamp Falls, as determined by subtracting the chinook counted through the fishway from the Petersen population estimate for the entire river system, corrected for catch components (i.e. 100,000 - 33,000 catch estimate - 64,000 fishway count = 3,000). However, visual observations by the authors indicated that much higher numbers of chinook spawned below the falls in 1984.

The dead recovery produced only 3,220 chinook below Stamp Falls (Table 7). Using the 20% dead recovery efficiency estimated in a previous section, the actual spawning poplation below the falls may have been 16,100. This estimate assumes that no spawned out fish moved from above to below the falls. In the 1985 Somass River study, Lightly (MS 1987) found no movement of tagged carcasses from the area above Stamp Falls to the areas below, although it is possible that moribund fish could move between the two areas.

The estimate of 16,100 chinook below the falls could be reconciled with the fishway counts of 64,000 by assuming that some of the fish which ascended the falls were washed back downstream during the severe October flood and stayed there. While this uncertainty cannot be resolved with the information available, it is of minor importance compared to the estimate of the total escapement.

The annual escapements of chinook to the Robertson Creek Hatchery and the Somass River system are shown for the period 1954 to 1984 in Figure 2 and Table 1. Until 1983, the river escapement was estimated by Fishery Officers. Their estimates ranged from 7,500 to 15,000 fish and showed little variation even after large numbers of chinook began returning to the Robertson Creek Hatchery in 1977 (Fig. 2). It is possible that the standard walking surveys used in the earlier assessments of the Somass system escapement could have underestimated the actual chinook abundance by an order of magnitude. However, while the use of the Petersen population estimate in 1984 likely provided a more precise measure of the actual river escapement, further studies are necessary to resolve the assumptions and biases inherent in this method.

INCIDENCE OF ADIPOSE MARKS AND CWT TAGS

Only a portion of the adipose-clipped chinook observed in the river and at the hatchery provided coded wire tag readings (18 out of 97 for the river and 84 out of 102 for the hatchery, Table 13). Some pins were lost during the dissection and decoding processes, while some of the "no pin" fish may have been the result of tag loss during the life of the fish, or fin rot in the spawned out fish. To correct for the latter possibility, it was assumed that the "no pin" rate observed in the hatchery recovery (16 out of 102 fish or 0.157, Table 13) was the true value while the higher rate observed in the river dead recovery (6 out of 27 or 0.222, Table 13) included rotted adipose fins interpreted as marks. Each rate was applied to the total of 97 apparent marks observed in the river dead recovery and the difference of six marks between the resulting values treated as an error. Subtracting this from the total of 97 marks yielded 91 "true" marks. Another possibility for "no pin" heads could have been the occurrence of naturally missing adipose fins. However, no relevant data specific to the Somass chinook stock were available, and no correction was made.

Much of the difference observed between recovery rates for different locations (Table 15) was likely due to bias from variable mark detection rates which were probably related to recovery methods. The significantly lower ($p<.05$) mark rate in the dead recovery compared to the hatchery is probably an indication that fish of hatchery origin show a greater tendency to enter the production facility.

Except for the anomaly in river section B where the recovery rate of adipose-marked males was unusually high, the mark recovery rate was generally similar for all river sections (Table 17). This may indicate that the hatchery fish were dispersed throughout the river, or that the hatchery-bound fish were swept downstream during the severe October flood. Separation by sex of the estimated adipose-marked population in the river system was not attempted due to uncertainties in the sex ratio.

CONTRIBUTION OF HATCHERY AND NATURAL PRODUCTION TO NATURALLY SPAWNING ESCAPEMENT

The naturally spawning chinook in the Somass River system could not be separated reliably into hatchery and wild components due to the unavailability of actual adipose-coded mark rates in the hatchery component. The two separate estimates of this rate utilized hatchery mark rate at release and mark rate in the hatchery returns. The mark rate as release will be incorrect if tagged and untagged fish survive at different rates or if their relative numbers are estimated incorrectly. Using the mark rate in the hatchery returns may correct for these biases, but only if no significant numbers of naturally produced fish return to the hatchery, a situation unlikely in natural systems (PSARC MS 1987).

The hatchery component of 14,882 chinook estimated in the naturally spawning river population, using the mark rate at release (Table 18), is probably an underestimate of the true value. The reason is that fish with adipose-coded marks probably suffered greater mortality and returned at a lower rate than the unmarked fish. On the other hand, the hatchery component of 37,717 chinook estimated using the mark rate in hatchery returns, is probably an overestimate of the true value, if straying of wild chinook occurred into the hatchery. Brailer counts at the Robertson Creek hatchery since 1962 indicate that very few chinook entered the hatchery prior to the commencement of hatchery returns. However, this evidence is not conclusive since the large numbers of hatchery-produced chinook presently entering the hatchery may influence the entry of wild fish.

Despite the above uncertainties in determining the hatchery and wild components in the river escapement, the large spawning population observed in the river combined with the extensive rearing areas in the system, indicate significant natural production.

BIOLOGICAL SAMPLING

Sex composition

The lower proportion of females observed in the hatchery returns (30.4%) compared to the river dead recovery (62.4%) has been typical of hatchery populations in the past (Sibert and Schnute 1982). The bias toward males in the hatchery returns may be due to a greater reluctance by females to use the fishway into the hatchery. Indirect evidence for this consists of observations at the fishway by the recovery crew, and the 1984 dead recovery data which showed that more females were dead-pitched in the river below the Stamp Falls (70.3%) than above (60.2%, Table 7). In addition, data from beach seining and live tagging in 1985 in the lower Somass River, well downstream of the fishway barrier, showed a nearly equal chinook sex ratio of 54.5% males and 45.6% females (Lightly MS 1987).

The bias toward females in the river dead recovery is attributed to sex related behavioral differences. Females tend to hold over their redds in shallow water after spawning while males tend to wander about and become less available for recovery. This phenomenon has been noted for different salmon species by Petersen (1954), Ward (1959), Eames and Hino (1981) and Eames et al. (1981).

A better indication of sex ratio in the spawning population may be obtained by combining the sex composition data from river recoveries and hatchery returns (Table 19) in order to reduce the respective biases toward males and females. However, a far better approach is to sample for sex ratio during live tagging below the spawning grounds or at the fishway (Shardlow et al. 1986). In the present study, chinook were not sexed during tagging in Alberni Inlet in order to minimize fish stress from handling. Chinook were also not sexed during the fishway counts since this method allowed only brief viewing of individual fish. More representative data on chinook sex composition have been available since 1986 when a video camera was installed at the fishway (K. Pitre, pers. comm.).

Age composition

The age structure obtained from sampling river carcasses was likely biassed since dead pitches are selective for size and sex (smaller fish may be washed out of the system before recovery and females are more recoverable than males, PSARC MS 1987). Also, some uncertainty in scale reading occurred due to possible scale resorption. More reliable age composition data may be provided by sampling for scales during tagging, but this would increase handling stress and probably mortality.

No attempt was made to estimate the age at return of the hatchery population using age data from CWT analysis (Table 13). The underlying assumptions for this method would be that a constant proportion of the annual hatchery releases is marked, that the marked and unmarked fish survive at the same rate, and that the two groups return at the same age. While an expansion factor would correct for differences in annual proportions marked, the other assumptions may not be valid and should be tested in an age sampling program on the unmarked hatchery populations.

Spawning success

The high rate of pre-spawning mortality observed below the Stamp Falls (69%) compared to above (19%, Table 21) may be attributed in part to the exhaustion of fish at the velocity barrier created at the falls during the October flood. In 1985 chinook females also suffered a higher pre-spawning mortality below the falls (25%) compared to above (11%), but this was attributed to possible stress from high water temperatures (Lightly MS 1987). Further studies are required to clarify causes for the differential pre-spawning mortality in the Somass River system.

SUMMARY

1. The 1984 chinook escapement to the Somass River system was assessed using fishway counts, dead pitch recoveries and Petersen mark/recapture.

2. A total of 704 chinook adults were spaghetti-tagged in the Alberni Inlet between September 5 and 29, 1984. Of these, 38 tags were subsequently recovered in the river and 37 tags at the Robertson Creek Hatchery.

3. Total chinook escapement over the Stamp Falls fishway was estimated at 63,776 ± 10%. Migration was disrupted by a severe flood in October.

4. River dead recovery totalled 14,774 chinook.

5. Returns to the Robertson Creek Hatchery totalled 11,032 chinook.

6. Petersen-type population estimate based on live tagging and subsequent tag recoveries in the river and the hatchery gave an overall population estimate, prior to entry on the spawning grounds, of 100,000 chinook. Of these, approximately 33,000 were captured in the local sport and native fisheries, 11,000 entered the hatchery and 56,000 spawned in the river. The latter value is approximately an order of magnitude higher than the previous historical escapement estimates.

7. The above Petersen population estimate was corrected for tagging mortality of 29%, tag loss of 9% and tag non-detection/non-reporting of 10%. Tag recoveries at the fishway and in diving surveys were not used in the population estimates due to apparent significant non-detection of tags.

8. Adipose-coded wire tagged chinook recoveries totalled 91 (0.0062 recovery rate) in the river dead recovery and 102 (0.0092 recovery rate) in the hatchery returns. Based on this, a total of 448 adipose marks were estimated in the total system (river and hatchery) escapement.

9. The estimated naturally spawning river population (56,000) could not be separated reliably into hatchery and wild components. Estimates of the wild component ranged from 18,283 to 41,118 chinook.

10. Sex composition was 37.6% males and 62.4% females in the river dead recoveries, 69.6% males and 30.4% females in the hatchery, and 51.3% males and 48.7% females for the total system.

11. Age composition based on scale samples from dead recoveries was age two - 5.0%, age three - 11.4 %, age four - 69.3%, and age five - 14.3%.

12. Pre-spawning mortality of females averaged 46.7% and was much higher below the falls (68.8%) than above (19.1%).

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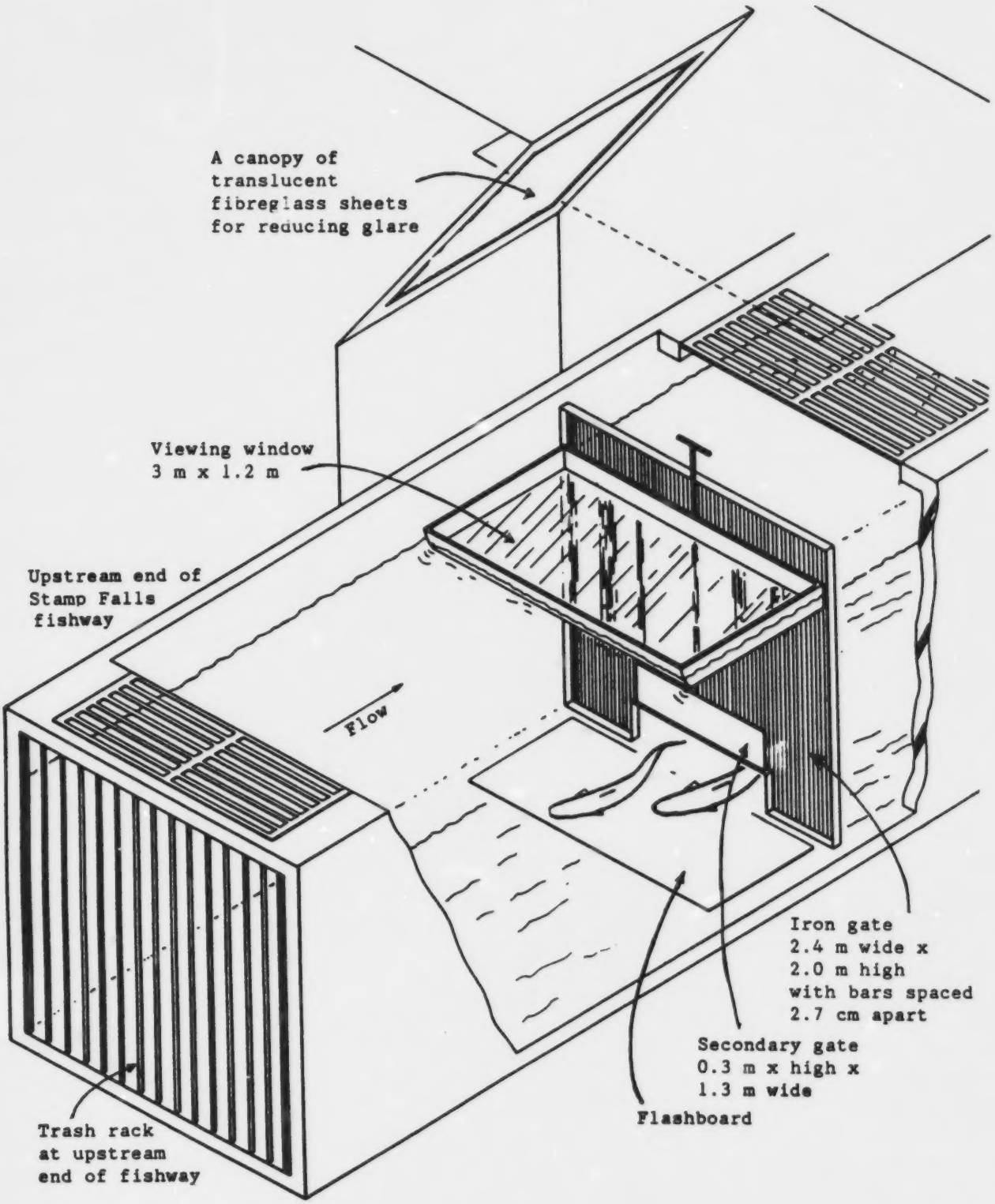

Appendix Fig. 1. Diagram of the fish counting facility installed at the upstream end of Stamp Falls fishway, September - November 1984.

Appendix 2. Daily counts of salmonids through Stamp Falls fishway at half-hour intervals, September 6 - November 6, 1984.

Appendix 2.1. Steep falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN 0	TAGS COL[d]	COHO ADLT	COHO JKS	SOCK	STLD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
SEPT 06	2.5	6	1	0	0	0	0	0	0	2	0		too dark
		6.5		0	0	0	0	3	0	9	0		to see
		7		5	2	7	0	11	0	30	12		
		7.5		5	0	5	0	22	0	25	12		
		8		11	7	18	0	15	0	42	11		
		8.5		10	3	13	0	44	0	59	15		
		9		8	6	14	0	22	0	36	6		
		9.5		1	0	1	0	4	0	5	1		
		10		0	0	0	0	0	0	1	0		
		10.5		1	0	1	0	2	0	33	1		
		11		0	0	0	0	0	0	0	0		
		11.5		0	0	0	0	1	0	3	1		
		12		1	1	2	0	5	0	10	1		
		12.5		0	1	1	0	2	0	3	0		
		13		1	0	1	0	10	2	14	0		
		13.5	2	0	1	1	0	12	1	22	0		
		14		2	2	4	0	15	2	10	0		
		14.5		0	0	0	0	50	4	43	6		
		15		2	0	2	0	36	3	36	7		
		15.5		4	0	4	0	23	3	38	4		
		16		0	0	0	0	1	0	5	1		
		16.5		1	0	1	0	10	0	16	0		
		17		1	0	1	0	15	0	14	0		
		17.5		1	0	1	0	8	1	8	1		
		18		2	0	2	0	3	1	4	0		
		18.5		2	1	3	0	3	0	12	1		
		19		3	1	4	0	8	1	13	4		
		19.5		4	0	4	0	10	3	21	1		
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				65	25	90	0	335	21	514	85		

[a] Used relative units of measure.
[b] Half-hour intervals begin at the times indicated.
[c] Observer codes 1-10 represent 10 different observers.
[d] Chinook tag color codes: W-white, R-red, B-blue, P-pink, R/W-red/white, Y/R-yellow/red.

Appendix 2.2. Steep falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN 0	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
SEPT 07	2.2	6	1	0	0	0	0		2	0	2	0	
		6.5		0	0	0	0		0	0	0	1	
		7		0	0	0	0		2	0	3	0	
		7.5		0	0	0	0		4	0	4	0	
		8		3	0	3	0		30	0	16	0	
		8.5		0	0	0	0		0	1	2	2	
		9		7	2	9	0		48	0	34	5	
		9.5		0	6	6	0		22	5	28	5	
		10		9	0	9	0		50	1	14	3	
		10.5		4	0	4	0		42	2	12	5	
		11		1	0	1	0		9	5	19	1	
		11.5		0	0	0	0		10	0	9	1	
		12		0	0	0	0		0	0	2	0	
		12.5		1	1	2	0		7	0	6	0	
		13	2	5	2	7	0		16	1	20	2	
		13.5		4	5	9	0		10	0	23	2	
		14		5	6	11	0		2	1	7	1	
		14.5		2	0	2	0		11	2	13	5	
		15		0	0	0	0		0	1	2	1	
		15.5		3	7	10	0		0	2	10	1	
		16		3	0	3	0		8	1	7	3	
		16.5		13	6	19	0		42	2	50	5	
		17		13	0	13	0		19	0	13	12	
	2	17.5		6	2	8	0		18	2	20	2	
		18		1	0	1	0		8	0	8	2	
		18.5		2	1	3	0		13	1	11	5	
		19		13	0	13	0		24	2	23	3	
		19.5		8	0	8	0		9	4	13	3	
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				103	38	141	0		406	33	371	70	

a-d As in Appendix 2.1.

Appendix 2.3. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
SEPT 08	2	6	1	2	0	2			7	0	11	0	
		6.5		0	0	0			2	0	5	0	
		7		2	1	3			15	1	13	6	
		7.5		2	0	2			25	2	15	7	
		8		6	2	8			47	2	11	5	
		8.5		3	0	3			42	2	14	9	
		9		5	2	7			33	4	11	16	
		9.5		0	1	1			17	1	11	7	
		10		0	0	0			10	1	0	2	
		10.5		4	0	4			32	7	6	4	
		11		2	0	2			24	0	1	4	
		11.5		0	0	0			17	0	4	5	
		12		0	0	0			6	0	0	0	
		12.5		1	0	1			12	0	7	2	
		13	3	2	0	2			6	0	9	0	
		13.5		1	0	1			10	0	13	1	
		14		1	4	5			26	2	18	6	
		14.5		0	2	2			5	0	3	6	
		15		0	2	2			5	4	8	2	
		15.5		0	0	0			19	1	11	8	
		16		5	0	5			17	0	13	16	
		16.5		10	0	10			33	4	21	15	
		17		7	0	7			21	0	15	14	
		17.5		5	0	5			10	0	6	15	
		18		0	1	1			4	3	6	7	
		18.5		5	3	8			15	1	12	12	
		19		1	0	1			4	1	4	6	
		19.5		4	3	7			4	0	1	3	
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				68	21	89	0		468	36	249	178	

[a-d] As in Appendix 2.1.

Appendix 2.4. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN 0	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
SEPT 09	2	6	1	0	0	0			2	0	3	0	
		6.5		1	0	1			6	1	3	2	
		7		3	0	3			6	3	6	0	
		7.5		4	0	4			34	3	5	4	
		8		14	2	16			88	10	15	7	
		8.5		7	1	8			16	1	7	2	
		9		4	0	4			10	2	14	1	
		9.5		3	0	3			18	1	16	0	
		10		5	0	5			18	1	5	4	
		10.5		2	0	2			5	1	7	1	
		11		1	0	1			9	2	3	0	
		11.5		0	0	0			2	0	2	0	
		12		2	0	2			7	4	2	1	
		12.5		0	0	0			4	3	3	1	
		13	3	0	0	0			1	0	2	0	
		13.5		0	6	6			18	0	24	24	
		14		1	1	2			16	1	3	1	
		14.5		2	3	5			13	0	4	4	
		15		4	2	6			58	4	14	4	
		15.5		1	2	3			21	1	21	7	
		16		0	1	1			8	3	2	0	
		16.5		4	10	14			63	3	38	15	
		17		0	3	3			43	4	5	0	
		17.5		3	10	13			76	10	64	24	
		18		0	1	1			7	0	1	0	
		18.5		0	4	4			22	0	24	7	
		19		1	2	3			19	0	4	0	
		19.5		3	0	3			6	0	10	1	
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				65	48	113	0		596	58	307	110	

[a-d] As in Appendix 2.1.

Appendix 2.5. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN 0	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
SEPT 10	2	6.5	2	4	0	4			29	4	38	5	
		7		20	6	26			73	2	78	8	
		7.5		38	13	51			103	7	99	38	
		8		26	11	37			82	2	56	13	
		8.5		32	8	40			212	12	119	44	
		9		35	13	48			127	8	97	25	
		9.5		25	10	35			148	12	102	26	
		10		11	4	15			34	2	29	3	
		10.5		3	0	3			8	1	7	0	
		11		6	2	8			24	5	44	7	
		11.5		13	4	17			33	5	25	4	
		12		9	1	10			9	4	13	3	
		12.5		4	3	7			24	4	23	8	
	2.3	13	1	7	0	7			8	1	5	1	
		13.5		11	6	17			34	3	12	8	
		14		44	13	57			71	6	16	16	
		14.5		42	8	50			59	8	6	16	
		15		47	10	57			74	12	19	8	
		15.5		72	37	109			149	20	35	16	
		16		1	0	1			4	3	2	1	
		16.5		3	1	4			4	0	2	0	
		17		2	0	2			4	3	18	1	
		17.5		0	0	0			0	0	0	0	
		18		7	0	7			5	4	16	4	
		18.5		1	0	1			4	1	5	0	
		19		1	0	1			8	0	5	1	
		19.5											
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				464	150	614	0		1330	129	871	256	

a-d As in Appendix 2.1.

Appendix 2.6. Steep falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN 0	TAGS COHO CDL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
SEPT 11	2	6.5	2	15	2	17		34	16	42	3		
		7		4	1	5		8	1	9	1		
		7.5		0	0	0		0	0	1	0		
		8		7	0	7		44	3	25	1		
		8.5		7	0	7		66	4	24	2		
		9		2	1	3		83	11	50	9		
		9.5		2	1	3		23	1	11	3		
		10		7	0	7		42	5	22	2		
		10.5		2	0	2		36	3	18	2		
		11		2	0	2		62	5	14	4		
		11.5		8	0	8		34	6	18	2		
		12		3	0	3		94	4	43	14		
		12.5		0	0	0		22	2	8	0		
		13	1	6	1	7		42	6	8	1		
		13.5		17	6	23		41	7	25	5		
		14		9	3	12		28	5	10	8		
		14.5		19	14	33		46	14	26	11		
		15		4	9	13		31	12	17	12		
		15.5		14	3	17		43	5	20	9		
		16		11	2	13		62	7	27	20		
		16.5		0	0	0		2	3	2	1		
		17		1	0	1		3	4	10	1		
		17.5		12	6	18		38	6	22	9		
		18		7	6	13		17	7	8	0		
		18.5		12	7	19		27	3	12	2		
		19		3	1	4		6	1	6	0		
		19.5		4	1	5		16	4	7	6		
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				178	64	242	0	950	145	485	128		

[a-d] As in Appendix 2.1.

Appendix 2.7. Staap falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN 0	TAGS COL[d]	COHO	COHO JKS	SOCK	SILD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
SEPT 12	2	6.5	2	23	1	24			108	10	74	6	
		7		8	0	8			26	1	15	1	
		7.5		4	0	4			39	0	16	1	
		8		6	2	8			193	4	45	16	
		8.5		5	0	5			107	7	34	2	
		9		8	1	9			118	8	36	11	
		9.5		6	3	9			120	19	33	10	
		10		3	0	3			13	3	6	0	
		10.5		1	1	2			26	8	20	0	
		11		11	3	14			72	7	38	5	
		11.5		4	2	6			31	2	6	1	
		12		4	0	4			26	3	22	1	
		12.5		4	0	4			50	2	22	3	
	2.4	13	1	7	0	7			42	3	8	2	
		13.5		4	0	4			3	2	6	0	
		14		17	0	17			39	8	17	5	
		14.5		27	0	27			31	4	18	5	
		15		23	0	23			69	9	19	10	
		15.5		20	0	20			40	3	19	6	
		16		63	0	63			42	4	27	10	
		16.5		31	0	31			34	5	15	4	
		17		26	0	26			32	2	8	3	
		17.5		40	0	40			45	14	33	2	
		18		26	0	26			21	4	11	3	
		18.5		20	0	20			12	6	34	0	
		19		14	0	14			5	3	16	0	
		19.5		3	0	3			4	2	6	0	
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				408	13	421	0		1348	143	604	107	

a-d As in Appendix 2.1.

Appendix 2.8. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN 0	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
SEPT 13	2	6.5	2	18	4	22			54	8	91	4	
		7		3	0	3			7	0	11	0	
		7.5		2	0	2			62	2	14	4	
		8		0	0	0			109	3	21	1	
		8.5		5	1	6			188	10	40	5	
		9		4	0	4			46	3	17	3	
		9.5		1	0	1			88	8	60	8	
		10		4	1	5			54	11	35	3	
		10.5		1	0	1			38	7	25	0	
		11		9	5	14			36	5	41	3	
		11.5		9	0	9			3	1	4	1	
		12		0	0	0			0	1	3	0	
		12.5		0	0	0			7	2	15	0	
	2.3	13	1	2	0	2			8	1	6	1	
		13.5		13	0	13			17	5	19	1	
		14		15	0	15			15	8	7	4	
		14.5		6	0	6			13	2	1	2	
		15		3	0	3			2	0	0	0	
		15.5		39	0	39			49	7	14	8	
		16		6	0	6			14	2	0	1	
		16.5		3	0	3			5	3	1	0	
		17		6	0	6			14	3	10	2	
		17.5		2	0	2			3	2	2	0	
		18		1	0	1			10	2	12	2	
		18.5		22	0	22			14	3	20	7	
		19		35	0	35			24	3	10	1	
		19.5		10	0	10			20	0	5	4	
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				219	11	230	0		900	102	484	65	

[a-d] As in Appendix 2.1.

Appendix 2.9. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN 0	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
SEPT 14	2	6.5	2	3	0	3			9	1	28	2	
		7		2	0	2			8	2	14	1	
		7.5		1	0	1			21	1	9	3	
		8		6	0	6			129	12	65	5	
		8.5		10	5	15			226	11	61	10	
		9		4	1	5			47	4	33	5	
		9.5		5	1	6			38	7	30	2	
		10		16	10	26			119	13	69	9	
		10.5		11	3	14			34	4	20	3	
		11		2	0	2			16	8	14	0	
		11.5		2	1	3			8	3	7	0	
		12		0	2	2			29	2	13	4	
		12.5		3	0	3			11	4	12	0	
	3.5	13	1	0	0	0			0	0	0	0	
		13.5		0	0	0			4	0	2	1	
		14		2	0	2			14	3	3	0	
		14.5		2	0	2			14	6	4	0	
		15		6	0	6			15	6	6	5	
		15.5		18	0	18			45	6	12	5	
		16		46	0	46			113	8	41	6	
		16.5		42	0	42			139	12	37	12	
		17		44	0	44			106	18	24	15	
		17.5		18	0	18			52	7	19	3	
		18		51	0	51			74	4	20	3	
		18.5		0	0	0			0	0	1	0	
		19		0	0	0			2	0	1	0	
		19.5		0	0	0			8	0	2	1	
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				294	23	317	0		1281	142	547	95	

[a-d] As in Appendix 2.1.

Appendix 2.10. Steep falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
SEPT 15	3	6.5	4	8	0	8			48	5	44	2	
		7		0	0	0			10	0	4	0	
		7.5		5	0	5			50	3	20	4	
		8		6	1	7			85	2	34	0	
		8.5		9	1	10			100	11	35	4	
		9		12	0	12			60	1	21	2	
		9.5		23	3	26			131	20	43	9	
		10		5	0	5			31	4	3	0	
		10.5		0	0	0			33	7	12	0	
		11		0	0	0			16	3	4	1	
		11.5		0	0	0			9	1	1	0	
		12		0	0	0			8	0	1	0	
		12.5		0	0	0			23	4	10	1	
	3	13	5	0	1	1			22	0	26	1	
		13.5		0	7	7			20	0	25	0	
		14		15	2	17			36	2	31	5	
		14.5		2	0	2			41	2	18	2	
		15		5	0	5			70	0	11	3	
		15.5		2	2	4			50	0	21	6	
		16		11	11	22			32	0	27	7	
		16.5		0	0	0			13	0	5	1	
		17		4	2	6			81	0	57	17	
		17.5		5	1	6			32	1	90	11	
		18		1	1	2			11	0	17	7	
		18.5		3	0	3			9	0	44	9	
		19		6	1	7			10	0	33	13	
		19.5		6	1	7			12	2	18	8	
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				128	34	162	0		1043	68	655	113	

[a-d] As in Appendix 2.1.

Appendix 2.11. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN 0	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
SEPT 16	3.3	6.5	6	0	0	0			5	0	3	0	
		7		13	0	13			21	1	13	3	
		7.5		79	0	79			74	7	33	10	
		8		130	0	130			68	2	13	16	
		8.5		203	0	203			96	2	31	10	
		9		264	0	264			127	3	29	30	
		9.5		139	0	139			113	1	42	16	
		10		194	0	194			96	10	77	20	
		10.5		178	0	178			143	11	84	19	
		11		147	0	147			88	12	40	10	
		11.5		48	0	48			53	8	54	6	
		12		88	0	88			65	4	59	9	
		12.5		10	0	10			17	1	10	4	
	3.3	13	5	20	0	20			80	0	135	41	
		13.5		0	0	0			17	1	9	4	
		14		15	0	15			93	3	166	88	
		14.5		9	0	9			16	1	22	5	
		15		3	0	3			15	0	22	3	
		15.5		23	0	23			81	0	152	64	
		16		16	0	16			38	0	43	12	
		16.5		13	0	13			109	0	94	22	
		17		26	0	26			89	0	99	35	
		17.5		14	0	14			71	0	61	6	
		18		22	0	22			35	0	43	13	
		18.5		33	0	33			51	0	48	3	
		19		101	0	101			66	0	100	22	
		19.5		25	0	25			6	0	24	2	
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
				1813	0	1813	0		1733	67	1506	473	

[a-d] As in Appendix 2.1.

Appendix 2.12. Staap falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
SEPT 17	3.7	6.5	1	14	0	14			9	0	8	2	
		7		50	0	50			23	0	18	14	
		7.5		33	0	33			34	1	14	5	
		8		36	0	36			52	6	15	12	
		8.5		71	0	71			101	3	26	14	
		9		13	0	13			208	9	38	22	
		9.5		129	0	129			193	9	32	27	
		10		122	0	122			202	11	58	28	
		10.5		77	0	77			186	12	42	17	
		11		94	0	94			209	12	71	10	
		11.5		123	0	123			154	15	50	8	
		12		40	0	40			68	4	20	6	
		12.5		95	0	95			119	7	65	7	
		13	2	73	8	81			123	1	115	6	
		13.5		69	6	75			92	3	53	5	
		14		56	12	68			148	12	84	9	
		14.5		90	16	106			81	5	62	10	
		15		63	7	70			115	4	51	9	
		15.5		89	23	112			105	6	68	10	
		16		15	2	17			62	1	22	3	
		16.5		46	9	55			76	6	45	7	
		17		40	8	48			86	1	48	10	
		17.5		109	19	128			107	5	70	12	
		18		67	13	80			115	6	57	8	
		18.5		99	12	111			60	4	51	4	
		19		1	0	1			2	1	3	0	
		19.5		4	0	4			11	1	16	1	
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				1718	135	1853	0		2741	145	1202	266	

[a-d] As in Appendix 2.1.

Appendix 2.13. Staap falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
SEPT 18	4	6.5	1	21	0	21			39	3	11	0	
		7		3	0	3			4	1	1	0	
		7.5		5	0	5			15	2	4	0	
		8		16	0	16			75	4	25	5	
		8.5		32	0	32			84	5	20	7	
		9		29	0	29			159	5	42	2	
		9.5		106	0	106			267	5	46	13	
		10		42	0	42			208	6	35	9	
		10.5		41	0	41			90	1	23	4	
		11		21	0	21			92	3	51	2	
		11.5		14	0	14			75	2	27	1	
		12		31	0	31			131	11	45	12	
		12.5		26	0	26			79	9	19	4	
		13	2	25	0	25			173	8	77	11	
		13.5		42	0	42			87	8	46	8	
		14		13	0	13			114	5	41	6	
		14.5		43	0	43			94	8	75	9	
		15		37	3	40			137	9	59	12	
		15.5		73	0	73			97	7	72	11	
		16		32	0	32			91	6	30	9	
		16.5		56	0	56			56	3	36	3	
		17		75	0	75			155	7	57	12	
		17.5		8	0	8			30	2	16	2	
		18		21	0	21			110	10	52	6	
		18.5		77	0	77		1W	72	5	55	3	
		19		42	0	42			86	7	53	4	
		19.5		6	0	6			16	0	6	0	
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				937	3	940	1		2636	142	1024	155	

[a-d] As in Appendix 2.1.

Appendix 2.14. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
SEPT 19	4.1	6.5	1	30	0	30			63	4	23	3	
		7		53	0	53			62	1	21	3	
		7.5		27	0	27			48	1	18	1	
		8		12	0	12			50	3	8	3	
		8.5		12	0	12			119	0	33	6	
		9		26	0	26			152	3	34	2	
		9.5		29	0	29			154	3	36	4	
		10		20	0	20			91	2	47	0	
		10.5		3	0	3			80	2	31	0	
		11		43	0	43			156	10	50	3	
		11.5		2	0	2			16	10	1	3	
	5.5	12		21	0	21			62	4	26	2	
	6.3	12.5		10	8	18			30	5	21	15	
		13	2	22	0	22			60	4	28	3	
		13.5		9	0	9			77	5	24	3	
		14		26	0	26	1W		74	14	43	6	
		14.5		2	0	2			53	9	22	2	
		15		11	0	11			37	3	15	2	
		15.5		2	0	2			48	15	13	4	
		16		9	0	9			61	10	29	4	
		16.5		6	0	6			81	11	23	6	
		17		25	0	25			68	15	30	5	
		17.5		22	0	22			56	20	22	5	
		18											GLASS
		18.5											BROKE
		19											
		19.5											
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				422	8	430	1		1698	154	598	85	

a-d As in Appendix 2.1.

Appendix 2.15. Steep falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN 0	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
SEPT 22	7.5	6.5	7	0	0	0			0	0	0	0	
		7		12	0	12			0	75	0	0	
		7.5		16	0	16			0	99	0	0	
		8		24	0	24			29	7	52	0	
		8.5		5	0	5			11	1	6	2	
		9		7	0	7			29	4	55	2	
		9.5		11	0	11			70	3	33	4	
		10		19	0	19			76	2	45	1	
		10.5		22	0	22			85	4	40	0	
		11		15	0	15			97	6	24	4	
		11.5		16	0	16			41	4	29	1	
		12		22	0	22			146	4	51	7	
		12.5		9	0	9			63	0	18	1	
		13	3	23	0	23			50	2	7	0	
		13.5		67	0	67			164	1	18	11	
		14		73	0	73			90	8	15	3	
		14.5		59	0	59			31	3	5	8	
		15		49	0	49			75	5	20	1	
		15.5		44	0	44			121	2	19	10	
		16		75	0	75			92	3	11	3	
		16.5		53	0	53			102	0	29	22	
		17		115	0	115			106	3	23	5	
		17.5		178	0	178			235	4	73	25	
		18		28	0	28			55	8	4	3	
		18.5		177	0	177			306	2	78	15	
		19		49	0	49			69	8	10	1	
		19.5		0	0	0			0	0	0	0	
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				1168	0	1168	0		2143	258	665	129	

a-d As in Appendix 2.1.

Appendix 2.16. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
		6.5											
SEPT 23	5.5	7	7	18	0	18			4	12	16	0	
		7.5		41	0	41			54	1	21	3	
		8		42	0	42			46	2	13	1	
		8.5		52	0	52			54	1	21	3	
		9		61	0	61			68	2	19	2	
		9.5		41	0	41			45	1	13	1	
		10		106	0	106		1M	128	4	40	7	
		10.5		19	0	19			19	0	6	2	
		11		110	0	110			181	3	35	8	
		11.5		132	0	132			90	2	46	6	
		12		75	0	75			141	10	41	2	
		12.5		125	0	125			77	0	53	4	
	5.2	13	3	186	0	186			196	0	15	2	
		13.5		102	0	102			74	4	13	0	
		14		212	0	212			214	1	42	5	
		14.5		50	0	50			54	3	7	1	
		15		126	0	126			178	1	28	2	
		15.5		144	0	144			117	14	26	3	
		16		214	0	214			182	0	4	0	
		16.5		68	0	68			57	5	13	2	
		17		152	0	152			214	0	10	1	
		17.5		90	0	90			83	5	23	3	
		18		156	0	156			134	0	25	0	
		18.5		105	0	105			76	12	21	4	
		19		136	0	136			116	0	33	2	
		19.5											
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				2563	0	2563	1		2602	83	584	64	

a-d As in Appendix 2.1.

Appendix 2.17. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENT[e]
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
SEPT 24	5	6.5	2	31	0	31			68	3	29	0	
		7		58	0	58			87	9	40	7	
		7.5		42	0	42			85	7	41	4	
		8		19	0	19			74	17	14	6	
		8.5		51	0	51			83	4	53	4	
		9		32	0	32			107	19	39	5	
		9.5		49	0	49			84	8	47	6	
		10		52	0	52			242	17	85	9	
		10.5		25	0	25			116	10	38	4	
		11		11	0	11			35	4	23	3	
		11.5		59	0	59			301	30	76	10	
		12		41	0	41			55	3	26	5	
		12.5		4	0	4			25	0	5	1	
	5	13	1	65		65							138
		13.5		42		42							98
		14		87		87							194
		14.5		109		109							215
		15		127		127							200
		15.5		192		192							218
		16		89		89							129
		16.5		0		0							0
		17		13		13							4
		17.5		132		132							214
		18		102		102							142
		18.5		283		283							6
		19		196		196	1	B/W					12
		19.5		0		0							0
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				1911	0	1911	1		1362	131	516	64	1570

[a-d] As in Appendix 2.1.

[e] From 13:00 tp 18:30 turbid water and viewing window repairs prevented distinguishing species of smaller fish.

Appendix 2.18. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN 0	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENT
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
		6.5											
SEPT 25	5	7	2	84	2	86			144	6	34	6	
		7.5		79	0	79			70	5	32	4	
		8		39	3	42			78	2	5	4	
		8.5		16	3	19			29	3	14	2	
		9		33	4	37			102	3	15	6	
		9.5		118	13	131			106	13	68	6	
		10		19	4	23			28	1	4	2	
		10.5		24	3	27			37	1	34	3	
		11		50	10	60			197	5	58	10	
		11.5		40	0	40			50	3	32	11	
		12		56	6	62			265	12	78	8	
		12.5		76	5	81			101	3	76	8	
	5	13	1	56	0	56			61	9	38	10	
		13.5		78	0	78			106	5	67	14	
		14		118	0	118			166	7	65	11	
		14.5		60	0	60			90	3	24	10	
		15		68	0	68			149	6	75	4	
		15.5		79	0	79			121	7	68	11	
		16		97	0	97			112	5	45	7	
		16.5		43	0	43			56	3	22	3	
		17		130	0	130			176	2	53	3	
		17.5		141	0	141			159	9	49	3	
		18		91	0	91			134	4	48	1	
		18.5		159	0	159			128	7	60	5	
		19		99	0	99			65	9	17	5	
		19.5											
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				1853	53	1906	0		2730	133	1081	157	

a-d As in Appendix 2.1.

Appendix 2.19. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENT
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
		6.5											
SEPT 26	5	7	2	49	8	57			72	5	20	8	
		7.5		4	0	4			16	1	0	1	
		8		47	8	55	1	R/W	68	5	13	5	
		8.5		30	1	31	1	W	55	2	13	4	
		9		14	0	14			37	3	20	7	
		9.5		29	6	35			116	7	38	7	
		10		53	6	59			85	5	63	8	
		10.5		76	10	86			224	11	57	8	
		11		60	5	65	1	P	139	9	69	9	
		11.5		56	8	64			156	10	48	9	
		12		54	6	60			102	11	54	7	
		12.5		41	3	44			158	10	51	10	
		13		14	1	15			51	5	19	3	
		13.5		8	0	8			63	6	11	3	
	4.8	14	1	59	0	59			95	2	32	3	
		14.5		76	0	76			95	1	25	2	
		15		50	0	50			81	5	28	2	
		15.5		55	0	55			94	5	52	4	
		16		126	0	126			171	6	53	3	
		16.5		73	0	73			64	8	21	2	
		17		115	0	115			108	6	33	1	
		17.5		69	0	69			53	0	24	0	
		18		84	0	84	1	R	125	7	31	3	
		18.5		131	0	131	1	B/W	151	3	47	3	
		19		25	0	25			61	1	20	1	
		19.5		20	0	20			26	0	27	3	
		20		61	0	61			33	3	8	1	
		20.5		22	0	22			7	5	8	4	
		21		48	0	48			17	1	12	0	
		21.5		17	0	17			6	3	4	0	
	4.8	22	8	13	4	17			8	2	6	0	
		22.5		22	0	22			10	0	8	0	
		23		17	0	17			6	1	2	0	
		23.5		7	0	7			7	2	7	0	
TOTALS				1625	66	1691	5		2560	151	924	121	

a-d As in Appendix 2.1.

Appendix 2.20. Staap falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENT
SEPT 27	4.8	0	B	1	0	1			1	0	1	0	
		.5		11	0	11			0	0	1	0	
		1		3	0	0			1	2	0	0	
		1.5		1	0	1			1	0	1	0	
		2		1	0	1			3	4	0	0	
		2.5		10	0	10			3	4	1	0	
		3		5	0	5			2	3	3	0	
		3.5		3	0	3			2	2	0	0	
		4		5	0	5			3	1	1	0	
		4.5		7	0	7			2	1	1	0	
		5		4	0	4			1	1	0	0	
		5.5		3	0	3			0	0	0	0	
		6	2	1	0	1			0	0	0	0	
		6.5		0	0	0			0	0	0	0	
		7		29	0	29	1	R/W	28	4	5	0	
		7.5		48	3	51	1	W	56	3	18	3	
		8		26	6	32			74	9	11	4	
		8.5		28	0	28			48	3	16	3	
		9		46	6	52			105	5	36	9	
		9.5		79	8	87			144	5	77	11	
		10		33	3	36			111	4	39	10	
		10.5		60	3	63			116	7	72	9	
		11		19	3	22			124	9	38	6	
		11.5		56	3	59			129	11	67	7	
		12		75	7	82			204	17	67	11	
		12.5		66	4	70			79	9	40	6	
		13		58	5	63			135	10	35	6	
		13.5		45	3	48			71	6	42	3	
		14	1	0	0	0			0	0	0	0	
		14.5		0	0	0			0	0	0	0	
		15		29	0	29			57	17	37	0	
		15.5		92	0	92			121	14	34	0	
		16		19	0	19			60	3	9	0	
		16.5		67	0	67			144	8	20	3	
		17		38	0	38			112	4	21	0	
		17.5		57	0	57			113	5	27	0	
		18		52	0	52			106	13	11	0	
		18.5		98	0	98			131	7	28	0	
		19		16	0	16			30	4	0	0	
		19.5		24	0	24			33	2	12	0	
		20		21	0	21			37	0	10	0	
		20.5		3	0	3			9	1	11	0	
		21		27	0	27			9	2	3	0	
		21.5		11	0	11			9	1	6	0	
		22	8	17	0	17			3	1	7	0	
		22.5		2	0	2			2	0	7	0	
		23		11	0	11			5	2	7	0	
		23.5		15	0	15			10	0	4	0	
TOTALS				1322	54	1373	2		2434	204	826	94	

a-d As in Appendix 2.1.

Appendix 2.21. Steep falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENT
SEPT 28	4.5	0	8	6	0	6			4	1	7	0	
		.5		4	0	4			1	0	1	0	
		1		3	0	0			0	1	2	0	
		1.5		9	0	9			2	0	2	0	
		2		4	0	4			1	1	2	0	
		2.5		9	0	9			2	0	4	0	
		3		5	0	5			3	2	2	0	
		3.5		3	0	3			1	0	2	0	
		4		2	0	2			0	1	0	0	
		4.5		2	0	2			1	2	1	0	
		5		5	0	5			0	3	2	0	
		5.5		1	0	1			1	1	3	0	
		6	2	5	0	5			2	1	3	1	
		6.5		0	0	0			0	0	0	0	
		7		13	0	13			11	10	5	2	
		7.5		7	0	7			16	0	4	1	
		8		5	0	5			3	0	1	1	
		8.5		11	3	14			81	13	15	3	
		9		19	0	19			63	4	35	6	
		9.5		12	2	14			98	18	24	4	
		10		55	0	55			172	10	84	14	
		10.5		25	0	25			178	17	61	6	
		11		3	0	3			9	0	5	0	
		11.5		3	0	3			51	7	13	2	
		12		31	0	31			86	8	45	6	
		12.5		40	0	40			122	18	42	10	
		13		16	0	16			56	4	17	4	
		13.5		15	0	15			67	7	30	1	
	4.2	14	1	27	0	27			46	5	6	1	
		14.5		64	0	64			119	6	29	0	
		15		71	0	71			131	4	15	0	
		15.5		30	0	30			86	3	19	0	
		16		68	0	68			126	8	33	0	
		16.5		34	0	34			81	7	19	2	
		17		24	0	24			76	7	16	0	
		17.5		141	0	141	1	B	143	10	52	1	
		18		87	0	87			123	4	14	2	
		18.5		35	0	35			77	8	9	1	
		19		37	0	37			41	9	15	0	
		19.5											
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				931	0	933	1		2080	200	639	68	

[a-d] As in Appendix 2.1.

Appendix 2.22. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENT
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
		6.5											
SEPT 29	4	7	7	76	0	76			73	8	35	4	
		7.5		85	0	85	1	B	39	4	18	3	
		8		11	0	11			16	1	3	4	
		8.5		48	0	48			107	3	38	5	
		9		37	0	37			104	3	28	2	
		9.5		47	0	47			156	4	40	3	
		10		69	0	69			178	11	62	7	
		10.5		34	0	34			108	7	21	4	
		11		30	0	30			84	4	29	2	
		11.5		51	0	51			96	6	23	2	
		12		38	0	38			97	5	24	7	
		12.5		15	0	15			75	2	20	2	
	3.9	13	3	24	0	24			65	3	31	1	
		13.5		8	0	8			69	6	28	11	
		14		31	0	31			40	4	48	1	
		14.5		43	0	43			89	10	41	10	
		15		42	0	42			51	7	67	0	
		15.5		26	0	26			80	3	46	7	
		16		38	0	38	1	R/W	52	7	41	3	
		16.5		28	0	28			78	6	21	4	
		17		38	0	38			38	3	35	0	
		17.5		84	0	84			134	2	49	13	
		18		108	0	108			64	8	53	2	
		18.5		43	0	43			58	5	37	4	
		19		31	0	31			24	6	17	0	
		19.5											
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				1085	0	1085	2		1975	128	855	101	

a-d As in Appendix 2.1.

Appendix 2.23. Steep falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENT
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
SEPT 30	3.9	6.5	7	2	0	2			0	0	0	0	
		7		13	0	13			25	2	9	2	
		7.5		31	0	31			12	2	10	1	
		8		30	0	30			35	2	14	2	
		8.5		70	0	70			98	1	28	3	
		9		73	0	73			132	8	48	5	
		9.5		100	0	100			137	5	41	9	
		10		41	0	41			79	0	38	1	
		10.5		112	0	112			146	10	39	6	
		11		58	0	58			69	5	30	2	
		11.5		81	0	81			120	4	28	4	
		12		52	0	52			93	3	18	6	
		12.5		78	0	78			114	4	19	7	
	3.8	13	3	159	0	159			117	6	64	7	
		13.5		97	0	97			55	6	45	2	
		14		75	0	75			89	3	54	11	
		14.5		18	0	18			27	7	24	2	
		15		73	0	73			79	5	42	10	
		15.5		114	0	114			77	8	41	1	
		16		108	0	108			74	4	33	5	
		16.5		61	0	61			33	4	19	0	
		17		95	0	95			100	5	43	14	
		17.5		162	0	162			34	10	51	1	
		18		116	0	116			52	5	32	8	
		18.5		44	0	44			22	3	21	0	
		19		34	0	34			18	1	16	3	
		19.5											
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				1897	0	1897	0		1837	113	807	112	

[a-d] As in Appendix 2.1.

Appendix 2.24. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENT
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
		6.5											
OCT 1	3.5	7	1	38	0	38			22	2	24	0	
		7.5		48	0	48			9	1	7	0	
		8		58	0	58			23	1	7	0	
		8.5		127	0	127			56	4	21	1	
		9		114	0	114	1	B	70	5	34	0	
		9.5		142	0	142			98	3	60	0	
		10		119	0	119	1	B	91	6	54	2	
		10.5		156	0	156			128	4	57	3	
		11		246	0	246	1	B	140	3	88	2	
		11.5		57	0	57			50	0	23	0	
		12		86	0	86	1	P	73	3	45	0	
		12.5		103	0	103			64	1	27	0	
		13		126	0	126			66	2	23	0	
		13.5		71	0	71			39	2	60	0	
		14	2	88	0	88			175	37	56	4	
		14.5		76	0	76			56	1	24	4	
		15		103	0	103			113	13	33	4	
		15.5		150	0	150	1	B	101	3	45	5	
		16		133	0	133	1	R/W	141	7	45	1	
		16.5		147	0	147			99	8	37	3	
		17		54	0	54	1	R	65	4	21	0	
		17.5		183	0	183	1	B	106	5	55	3	
		18		98	0	98	1	P	121	12	32	0	
		18.5		81	0	81	2	P	53	5	31	1	
		19		38	0	38			45	5	16	0	
		19.5											
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				2642	0	2642	11		2004	137	925	33	

a-d As in Appendix 2.1.

Appendix 2.25. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENT
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
		6.5											
OCT 2	3.4	7	1	26	0	26			14	1	24	0	
		7.5		85	0	85			41	2	9	0	
		8		56	0	56			33	1	8	2	
		8.5		84	0	84			59	2	33	2	
		9		67	0	67			94	1	54	0	
		9.5		66	0	66			62	5	49	1	
		10		120	0	120			93	6	72	6	
		10.5		85	0	85			104	3	54	1	
		11		57	0	57			71	2	38	0	
		11.5		31	0	31			23	1	19	0	
		12		35	0	35			49	3	24	0	
		12.5		49	0	49	1	R	56	2	22	0	
	3	13	2	0	0	0			0	0	0	0	
		13.5		95	0	95			94	6	50	5	
		14		94	3	97			47	5	25	1	
		14.5		89	3	92			70	2	30	2	
		15		135	4	139			83	4	22	3	
		15.5		103	5	108	1	R/W	65	9	20	4	
		16		92	7	99			39	1	19	3	
		16.5		157	4	161	1	W	101	1	20	1	
		17		121	3	124			43	1	23	5	
		17.5		20	2	22			17	4	5	1	
		18		32	5	37			19	2	18	3	
		18.5		75	1	76			61	6	28	1	
		19		11	0	11			6	0	5	0	
		19.5		63	0	63			29	2	25	2	
		20		58	0	58			13	0	23	0	
		20.5		50	0	50	1	W	22	0	10	3	
		21	8	50	0	50			4	2	8	0	
		21.5		39	0	39			2	0	11	0	
		22		22	0	22			6	1	5	0	
		22.5		29	0	29			0	0	3	0	
		23		13	0	13			2	0	2	0	
		23.5		15	0	15			0	1	2	0	
TOTALS				2124	37	2161	4		1422	76	760	46	

a-d As in Appendix 2.1.

Appendix 2.26. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
OCT 3	3.3	0	B	11	0	11	1	W	4	1	9	0	
		.5		6	0	6			4	0	8	0	
		1		8	0	0			2	1	7	0	
		1.5		10	0	10			2	0	5	0	
		2		10	0	10			6	0	7	0	
		2.5		7	0	7			3	2	1	0	
		3		9	0	9			1	1	2	0	
		3.5		15	0	15			3	2	2	0	
		4		5	0	5			1	1	2	0	
		4.5		8	0	8			0	0	2	0	
	3.3	5	1	5	1	6			0	0	5	0	
		5.5		11	1	12	1	R	0	0	1	0	
		6		6	0	6			0	0	2	0	
		6.5		13	0	13			1	0	0	0	
		7		18	1	19			0	0	1	1	
		7.5		44	7	51			9	0	7	1	
		8		30	4	34			20	2	21	0	
		8.5		31	4	35			12	1	13	1	
		9		125	38	163			71	5	82	6	
		9.5		227	12	239			80	2	117	2	
		10		91	10	101			37	2	79	1	
		10.5		101	11	112	1	R/W	47	3	116	3	
		11		167	28	195			60	2	80	1	
		11.5		122	10	132			56	0	62	4	
		12		180	13	193	1	P	69	4	64	6	
		12.5		178	16	194			52	0	52	3	
	3.2	13	2	130	21	151	1	B	70	6	9	13	
		13.5		245	22	267			56	3	24	1	
		14		118	9	127			47	5	7	3	
		14.5		237	0	237	1	P	48	4	32	2	
		15		208	8	216			79	1	11	4	
		15.5		266	0	266	1	R	50	2	21	3	
		16		156	0	156			68	5	8	4	
		16.5		185	0	185			48	4	21	2	
		17		161	0	161	1	B	72	3	7	1	
		17.5		27	0	27			13	1	15	2	
		18		199	6	205			68	3	11	6	
		18.5		174	9	183	1	W	28	2	24	0	
		19		0	0	0			0	0	0	0	GATE
		19.5		0	0	0			0	0	0	0	CLOSED
		20		0	0	0			0	0	0	0	GENERATOR
		20.5		0	0	0			0	0	0	0	BROKEN
		21	B	0	0	0			0	0	0	0	----------
		21.5		98	0	98	1	W	12	0	21	0	
		22		61	0	61			3	1	18	0	
		22.5		34	0	34	1	W	1	0	13	0	
		23		18	0	18			2	0	6	0	
		23.5		14	0	14			2	0	8	0	
TOTALS				3769	231	3992	11		1207	72	1003	70	

a-d As in Appendix 2.1.

Appendix 2.27. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENT
OCT 4	3.3	0	8	15	0	15			2	1	7	1	
		.5		3	0	3			1	0	5	0	
		1		11	0	0			1	0	3	0	
		1.5		8	4	12			2	0	6	0	
		2		13	2	15			1	2	6	0	
		2.5		4	0	4			3	0	5	0	
		3		20	1	21	1	W	1	0	6	0	
		3.5		12	0	12			0	0	0	0	
		4		14	2	16			3	0	4	0	
		4.5		10	0	10			2	1	3	0	
		5	1	5	1	6			0	1	4	0	
		5.5		12	0	12	1	R	0	0	3	1	
		6		5	0	5			0	0	2	0	
		6.5		13	0	13			0	0	1	1	
		7		17	2	19			0	0	1	1	
		7.5		47	7	54			10	0	7	1	
		8		28	5	33			18	3	23	0	
		8.5		30	3	33			13	2	10	1	
		9		126	28	154			65	3	80	5	
		9.5		224	12	236			85	1	105	1	
		10		90	9	99	1	R	37	1	80	0	
		10.5		100	12	112			42	5	116	4	
		11		167	31	198			52	2	75	3	
		11.5		122	10	132			58	0	60	2	
		12		180	10	190	1	B	59	0	55	7	
		12.5		178	15	193			51	3	42	2	
		13		145	4	149			72	2	10	5	
		13.5		145	11	156			42	3	22	2	
		14		232	12	244			70	1	21	8	
		14.5		129	11	140			33	1	16	1	
		15		189	11	200	1	P	75	2	9	11	
		15.5		201	17	218			41	7	18	6	
		16		270	14	284	1	B	90	7	13	10	
		16.5		223	25	248	1	B	47	2	9	3	
		17		216	18	234	1	W	63	4	6	2	
		17.5		214	21	235	1	R/W	43	6	18	7	
		18		152	4	156			50	3	7	4	
		18.5		80	6	86			27	1	13	7	
		19		33	2	35			13	0	3	0	
		19.5											
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				3683	310	3982	9		1172	64	874	96	

[a-d] As in Appendix 2.1.

Appendix 2.28. Staap falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENT
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
		6.5											
OCT 5	3.5	7	1	27	0	27	1	W	4	0	3	0	
		7.5		137	18	155			15	0	7	0	
		8		100	7	107			15	1	8	1	
		8.5		60	2	62			20	0	8	2	
		9		65	1	66			31	0	13	0	
		9.5		166	8	174			42	0	26	0	
		10		130	6	136			41	1	15	2	
		10.5		134	5	139			51	0	26	1	
		11		192	6	198	1	P	70	1	29	2	
		11.5		179	4	183			43	3	23	1	
		12		258	7	265			80	3	22	6	
		12.5		208	14	222	1	R/Y	65	3	18	1	
	3.6	13	2	218	5	223	1	P	35	2	6	1	
		13.5		217	6	223			31	0	14	6	
		14		282	16	298			48	2	10	4	
		14.5		226	6	232	1	W	40	4	18	3	
		15		236	8	244	1	P	50	5	5	2	
		15.5		237	4	241	1	P	22	2	13	12	
		16		286	5	291			57	3	7	5	
		16.5		293	20	313	1	R	36	1	18	1	
		17		313	8	321	1	P	50	3	5	4	
		17.5		195	9	204			24	4	8	1	
		18		249	9	258	1	R/W	53	1	6	4	
		18.5		161	6	167			17	0	10	1	
		19											
		19.5											
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				4569	180	4749	10		940	39	318	60	

[a-d] As in Appendix 2.1.

Appendix 2.29. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN 0	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENT
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
		6.5											
		7											
		7.5											
OCT 6	3.5	8	7	117	4	121			14	2	10	1	
		8.5		107	19	126			11	1	15	3	
		9		174	6	180			36	0	32	2	
		9.5		149	13	162	1	W	31	0	36	6	
		10		233	1	234			50	1	57	8	
		10.5		194	21	215	1	R/Y	35	0	41	1	
		11		200	1	201			52	4	47	5	
		11.5		176	16	192	1	W	39	0	28	4	
		12		234	0	234	1	P	46	1	28	2	
		12.5		117	11	128	1	P	23	2	20	1	
	3.6	13	6	108	16	124			21	4	18	2	
		13.5		165	10	175			13	2	12	0	
		14		110	6	116	3	P	18	0	12	6	
		14.5		118	5	123	1	P	28	3	28	5	
		15		206	19	225	1	W	17	0	47	2	
		15.5		175	10	185	1	B	39	4	24	4	
		16		157	9	166	1	W	22	4	17	1	
		16.5		128	6	0	1	R/Y	18	2	24	5	
		17		141	6	147	2	B	23	3	28	2	
		17.5		190	14	204	1	P	18	3	27	3	
		18		135	5	140	1	R/Y	14	2	26	0	
		18.5		97	4	101			9	2	12	2	
		19											
		19.5											
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				3431	202	3499	17		577	40	589	65	

a-d As in Appendix 2.1.

Appendix 2.30. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
OCT 7													
				WATER LEVEL ROSE FROM 3.6 UNITS AT 13:00 ON OCT 6 TO 7.7 UNITS AT 07:00 ON OCT 7, TO 9.5 UNITS AT 13:30 ON THE SAME DAY. FLOOD CONDITIONS PREVAILED TO SHORTLY AFTER OCT 19 BUT COUNTING RESUMED AT A SLIGHTLY LOWER LEVEL OF ACCURACY ON THAT DATE. BETWEEN OCT 6 AND OCT 19 WATER LEVELS COULD NOT BE RECORDED AS THE RIVER HEIGHT EXCEEDED STAFF GAUGE UPPPER MARGIN. IT IS BELIEVED THAT FEW FISH IF ANY WERE ABLE TO SUCCUMB THE VELOCITY BARRIER AT STAMP RIVER FALLS DURING THIS TIME PERIOD.								
TOTALS				0	0	0	0		0	0	0	0	

[a-d] As in Appendix 2.1.

Appendix 2.31. Staap falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN 0	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENT
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
		6.5											
		7											
		7.5											
		8											
		8.5											
		9											
		9.5											
		10											
		10.5											
		11											
OCT 19	9.2	11.5	2	2	0	2		0	4	0	0		FLOOD
		12		12	3	15		8	5	0	0		CONDITIONS
		12.5		46	13	59		28	6	8	0		OBSERVATION
		13		24	4	28		20	5	0	2		DIFFICULT
		13.5		34	2	36		30	9	0	0		AND
		14		26	0	26		65	6	0	0		ACCURACY
		14.5		20	0	20		37	3	0	0		QUESTION-
		15		28	0	28		35	11	0	0		ABLE
		15.5		15	0	15		48	6	0	0		
		16		3	0	3		52	2	0	0		
		16.5		6	0	6		59	2	0	0		
		17		2	0	2		53	6	0	0		
		17.5		88	0	88		0	0	0	0		
		18		112	0	112		0	0	0	0		
		18.5		53	0	53		0	0	0	0		
		19		24	0	24		0	0	0	0		
		19.5		33	0	33		0	0	0	0		
		20		49	0	49		0	0	0	0		
		20.5		0	0	0		0	0	0	0		
		21		4	0	4		0	21	0	0		
		21.5		0	0	0		0	0	0	0		
		22		1	0	1		0	4	0	0		
		22.5		0	0	0		0	0	0	0		
		23		0	0	0		0	0	0	0		
		23.5		0	0	0		0	0	0	0		
TOTALS				582	22	604	0	435	90	8	2		

[a-d] As in Appendix 2.1.

Appendix 2.32. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN 0	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENT
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
OCT 20	9.1	5	7	1	0	1			0	0	1	0	
		5.5		0	0	0			0	0	0	0	
		6		0	0	0			0	0	0	0	
		6.5		1	0	1			1	0	0	0	
		7		0	0	0			1	0	0	0	
		7.5		2	0	2			3	1	0	0	
		8		5	0	5			0	2	0	1	
		8.5		11	5	16			12	4	4	0	
		9		8	1	9			9	2	4	2	
		9.5		8	4	12			11	3	6	0	
		10		12	1	13			21	3	2	4	
		10.5		10	5	15			20	3	5	2	
		11		30	5	35			43	3	1	3	
		11.5		18	6	24			43	1	9	4	
		12		21	0	21			27	3	0	3	
		12.5		16	7	23			51	3	7	1	
		13	3	5	0	5			60	0	20	2	
		13.5		20	7	27			13	3	1	2	
		14		27	0	27			49	0	18	2	
		14.5		28	11	39			14	0	6	0	
		15		32	0	32			60	0	16	1	
		15.5		17	6	23			5	1	2	1	
		16		12	0	12			18	1	12	0	
		16.5		23	6	29			5	1	3	0	
		17		15	0	15			35	2	7	0	
		17.5		19	3	22			4	0	0	0	
		18		12	2	14			3	3	0	0	
		18.5											
		19											
		19.5											
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				353	69	422	0		508	39	124	28	

[a-d] As in Appendix 2.1.

Appendix 2.33. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN 0	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENT
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
		6.5											
		7											
OCT 21	8.1	7.5	7	1	0	1			2	0	0	0	
		8		8	1	9			3	1	1	0	
		8.5		7	3	10			15	2	2	0	
		9		14	4	18			9	4	3	2	
		9.5		14	4	18			9	2	3	0	
		10		18	4	22			7	2	2	0	
		10.5		5	3	8			12	2	1	1	
		11		15	3	18			14	1	2	0	
		11.5		33	8	41			13	1	6	1	
		12		15	1	16			20	1	1	0	
		12.5		10	3	13			8	2	2	0	
		13	3	10	0	10			16	0	3	0	
		13.5		6	2	8			4	2	0	0	
		14		12	0	12			26	0	11	0	
		14.5		17	3	20			4	0	2	1	
		15		5	0	5			26	0	12	0	
		15.5		6	3	9			10	0	0	0	
		16		0	0	0			1	0	0	0	
		16.5		3	2	5			4	0	0	0	
		17		8	0	8			18	0	12	0	
		17.5		9	2	11			8	0	1	0	
		18											
		18.5											
		19											
		19.5											
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				216	46	262	0		229	20	64	5	

a-d As in Appendix 2.1.

Appendix 2.34. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN 0	TAGS COD[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
		6.5											
		7											
OCT 22	8	7.5	2	3	0	3			0	0	0	0	
		8		6	0	6			0	0	0	0	
		8.5		15	0	15			0	0	0	0	
		9		17	0	17			0	0	0	0	
		9.5		17	0	17			0	0	0	0	
		10		6	0	6			0	0	0	0	
		10.5		13	0	13			0	0	0	0	
		11		16	0	16			0	0	0	0	
		11.5		17	0	17			0	0	0	0	
		12		0	0	0			0	0	0	0	
		12.5		0	0	0			0	1	0	1	
		13	1	3	0	3			8	2	2	2	
		13.5		4	0	4			10	0	5	0	
		14		7	0	7			5	0	2	0	
		14.5		1	0	1			6	0	1	0	
		15		5	0	5			5	1	1	1	
		15.5		1	0	1			1	1	1	1	
		16		4	0	4			1	0	0	0	
		16.5		0	0	0			0	2	0	2	
	7	17		2	1	3			1	0	0	0	
		17.5		5	0	5			0	0	0	0	
		18		0	0	0			0	7	0	7	
		18.5											
		19											
		19.5											
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				142	1	143	0		37	14	12	14	

[a-d] As in Appendix 2.1.

Appendix 2.35. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
		6.5											
		7											
OCT 23	6.5	7.5	2	9	0	9			0	0	0	0	
		8		13	0	13			0	0	0	0	
		8.5		7	0	7			0	0	0	0	
		9		8	0	8			0	0	0	0	
		9.5		11	0	11			0	0	0	0	
		10		9	0	9			0	0	0	0	
		10.5		12	0	12			0	0	0	0	
		11		8	0	8			0	0	0	0	
		11.5		15	0	15			0	0	0	0	
		12		12	0	12			0	0	0	0	
		12.5		20	0	20			0	0	0	0	
		13	1	6	0	6			0	0	0	0	
		13.5		1	0	1			0	0	0	0	
		14		5	1	6			0	0	0	0	
		14.5		15	2	17			0	0	0	1	
		15		14	1	15			2	0	0	0	
		15.5		14	1	15	1	B	4	0	0	1	
		16		39	3	42			2	0	0	2	
		16.5		16	1	17			1	0	0	2	
		17		63	0	63			2	0	0	2	
		17.5		24	1	25			4	0	0	0	
		18		3	1	4			1	0	0	0	
		18.5											
		19											
		19.5											
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				324	11	335	1		16	0	0	8	

[a-d] As in Appendix 2.1.

Appendix 2.36. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
		6.5											
		7											
OCT 24	5.5	7.5	2	66	0	66			0	0	0	0	TURBID
		8		87	0	87			0	0	0	0	WATER
		8.5		30	0	30			0	0	0	0	FROM SEMI
		9		27	0	27			0	0	0	0	FLOOD
		9.5		22	0	22			0	0	0	0	CONDITIONS
		10		11	0	11			0	0	0	0	PREVENTED
		10.5		29	0	29			0	0	0	0	ACCURATE
		11		29	0	29			0	0	0	0	COUNTING
		11.5		36	0	36			0	0	0	0	
		12		45	0	45			0	0	0	0	
		12.5		29	0	29			0	0	0	0	
	5	13	1	21	1	22			3	0	0	0	
		13.5		97	7	104			5	1	0	1	
		14		178	8	186	1	P	8	1	0	5	
		14.5		150	5	155			8	1	0	4	
		15		208	6	214			11	0	0	5	
		15.5		180	18	198	1	P	3	1	0	5	
		16		194	48	242			11	1	0	5	
		16.5		185	52	237			10	0	2	4	
		17		234	50	284			29	2	0	5	
		17.5		91	15	106			13	0	0	2	
		18		37	12	49			12	0	0	2	
		18.5											
		19											
		19.5											
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				1986	222	2208	2		113	7	2	38	

a-d As in Appendix 2.1.

Appendix 2.37. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
		6.5											
		7											
OCT 25	5.5	7.5	1	36	3	39			3	0	0	0	
		8		57	13	70			9	0	0	0	
		8.5		46	9	55			4	0	0	0	
		9		43	10	53			4	0	0	1	
		9.5		46	10	56			3	0	0	1	
		10		68	12	80	1	P	3	0	0	2	
		10.5		157	31	188	1	B	15	0	0	3	
		11		0	0	0			0	0	0	0	
		11.5		30	6	36			1	0	0	0	
		12		67	15	82			8	4	0	1	
		12.5		82	6	88			7	0	0	0	
		13	2	184	10	194			18	0	0	3	
		13.5		117	22	139			6	0	0	1	
		14		148	19	167			2	0	0	0	
		14.5		250	13	263	1	B	0	0	0	0	
		15		267	2	269			0	0	0	0	
		15.5		256	8	264			0	0	0	0	
		16		221	20	241			0	0	0	4	
		16.5		286	14	300			0	0	0	0	
		17		231	5	236			0	0	0	9	
		17.5		263	14	277			0	0	0	7	
		18		120	1	121			0	0	0	0	
		18.5		117	15	132	1	R/W	0	0	0	2	
		19		109	7	116			0	0	0	0	
		19.5		87	6	93			0	0	0	3	
		20		84	3	87			0	0	0	0	
		20.5		68	1	69			0	0	0	0	
		21	8	127	19	146			0	0	0	0	
		21.5		69	8	77			0	0	0	0	
		22		78	12	90			0	0	0	0	
		22.5		63	6	69			0	0	0	0	
		23		93	12	105			0	0	0	0	
		23.5		28	5	33			0	0	0	0	
TOTALS				3898	337	4235	4		83	4	0	37	

[a-d] As in Appendix 2.1.

Appendix 2.38. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
OCT 26	5.5	0	B	50	1	51			0	0	0	0	
		.5		36	5	41			0	0	0	0	
		1		21	7	0			0	0	0	0	
		1.5		0	0	0			0	0	0	0	
		2		6	0	6			0	0	0	0	
		2.5		30	3	33			0	0	0	0	
		3		14	0	14			0	0	0	0	
		3.5		21	0	21			0	0	0	0	
		4		29	4	33			1	0	0	1	
		4.5		26	2	28	1	W	0	0	0	0	
		5	1	38	3	41			0	0	0	0	
		5.5		72	2	74			0	0	0	0	
		6		21	0	21			0	0	0	0	
		6.5		8	1	9			1	0	0	0	
		7		0	0	0			0	0	0	0	
		7.5		0	8	8			0	0	0	0	
		8		7	1	8			0	0	0	0	
		8.5		11	1	12			1	0	0	0	
		9		36	5	41			2	0	0	0	
		9.5		22	0	22			1	0	0	0	
		10		22	1	23			1	0	0	0	
		10.5		40	3	43	1	W	11	0	0	1	
		11		82	25	107			12	0	0	4	
		11.5		81	10	91			5	0	0	2	
		12		103	15	118			10	0	0	1	
		12.5		144	28	172			12	0	0	0	
		13	2	96	10	106	1	W	2	0	0	3	
		13.5		97	8	105	1	R	2	1	0	4	
		14		145	13	158	1	B	9	0	0	4	
		14.5		129	8	137	1	B	2	0	0	5	
		15		155	14	169	1	W	9	0	0	7	
		15.5		102	11	113	1	R/W	11	0	0	6	
		16		135	23	158			11	0	0	3	
		16.5		192	11	203			9	1	0	16	
		17		143	17	160	1	R/W	16	0	0	7	
		17.5		206	19	225	1	W	14	2	0	13	
		18		243	31	274	1	B	30	0	0	14	
		18.5		154	17	171			9	0	0	11	
		19		197	15	212	1	R	7	0	0	10	
		19.5		178	10	188	2	R/W	8	0	0	7	
		20		167	11	178	1	P	6	0	0	5	
		20.5		108	10	118			2	0	0	3	
	5.5	21	B	77	20	97	1	W	3	0	0	1	
		21.5		73	26	101			8	0	2	2	
		22		69	15	84	2	W	1	0	0	2	
		22.5		101	12	113			4	0	1	3	
		23		39	8	47			0	0	0	0	
		23.5		84	11	95	1	W	2	0	2	1	
TOTALS				3812	445	4229	19		222	4	5	136	

a-d As in Appendix 2.1.

Appendix 2.39. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN TAGS #	CHIN TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
OCT 27	3.5	0	B	52	8	60	2	W	2	0	0	0	
		.5		49	5	54			1	0	2	0	
		1		34	3	0			0	0	0	0	
		1.5		33	2	35			0	0	0	0	
		2		30	1	31			0	0	0	0	
		2.5		46	1	47			0	0	0	0	
		3		43	7	50			0	0	0	0	
		3.5		24	1	25			1	0	0	0	
		4		25	0	25			0	0	0	0	
		4.5		23	3	26			0	0	0	0	
	3	5	9	0	0	0			0	0	0	0	
		5.5		0	0	0			0	0	0	0	
		6		0	0	0			0	0	0	0	
		6.5		0	0	0			0	0	0	0	
		7		0	0	0			0	0	0	0	
		7.5		0	0	0			0	0	0	0	
		8		0	0	0			0	0	0	0	
		8.5		0	0	0			0	0	0	0	
		9		0	0	0			0	0	0	0	
		9.5		0	0	0			0	0	0	0	
		10		23	1	24			1	0	0	0	
		10.5		38	2	40			0	0	0	2	
		11		126	7	133	1	R/W	11	0	0	1	
		11.5		163	20	183	1	R	42	0	0	4	
		12		169	7	176			20	0	0	5	
		12.5		92	2	94			12	0	1	8	
		13	1	52	6	58			5	0	0	2	
		13.5		126	22	148			14	0	3	1	
		14		60	11	71	1	B	12	3	0	3	
		14.5		101	18	119			5	2	0	8	
		15		114	20	134			10	4	0	8	
		15.5		160	11	171			19	3	1	5	
		16		103	15	118			25	4	5	7	
		16.5		159	34	193			13	0	2	7	
		17		157	20	177			7	0	3	13	
		17.5		101	14	115			2	3	1	7	
		18		75	12	87	1	R/W	10	2	1	7	
		18.5		136	29	165			9	5	1	8	
		19		172	30	202			7	3	3	3	
		19.5		130	46	176			6	2	1	4	
		20		128	24	152			8	3	1	4	
		20.5		184	37	221			10	1	1	2	
		21	8	23	3	26			2	0	0	0	
		21.5		20	1	21			0	0	0	1	
		22		15	4	19			0	0	0	0	
		22.5		17	1	18			1	2	0	0	
		23		20	0	20			0	0	0	0	
		23.5		18	1	19			0	0	0	0	
TOTALS				3041	429	3433	6		0	37	26	110	

a-d As in Appendix 2.1.

Appendix 2.40. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	TAGS #	TAGS COL[d]	COHO ADLT	COHO JKS	SOCK	STLD	COMMENTS
OCT 28	3	0	B	16	0	15			0	0	0	0	
		.5		11	1	12			1	0	0	0	
		1		25	3	0			0	0	0	0	
		1.5		34	4	38			0	0	0	0	
		2		16	0	16			0	0	0	0	
		2.5		7	0	7	1	W	0	1	0	0	
		3		9	0	9			0	1	0	0	
		3.5		12	1	13			0	0	0	0	
		4		14	1	15			0	0	0	0	
		4.5		12	0	12			0	0	0	0	
		5	1	15	0	15			1	0	0	0	
		5.5		4	1	5			0	0	0	0	
		6		1	0	1			0	0	0	0	
		6.5		3	0	3			0	1	0	0	
		7		5	1	6			1	0	0	0	
		7.5		21	5	26			2	0	0	0	
		8		11	1	12			1	0	1	2	
		8.5		12	2	14			4	0	0	0	
		9		18	2	20			2	0	3	1	
		9.5		12	3	15			6	0	0	0	
		10		19	4	23			2	2	3	3	
		10.5		47	10	57			5	0	2	3	
		11		37	7	44			2	2	1	3	
		11.5		40	11	51			4	0	0	1	
		12		38	4	42			7	2	0	0	
		12.5		53	6	59			14	0	0	4	
		13	10	71	6	77	1	B	14	0	0	5	
		13.5		57	6	63	2	B	11	0	1	23	
		14		79	6	85			15	0	0	5	
		14.5		70	4	74			18	0	2	12	
		15		70	2	72			8	0	1	7	
		15.5		52	3	55			14	0	2	15	
		16		52	3	55			14	0	1	10	
		16.5		23	2	25	1	B	11	0	3	10	
		17		43	1	44			4	0	0	4	
		17.5		31	2	33			4	0	0	4	
		18		23	3	26	1	B	1	0	3	1	
		18.5		15	0	15	1	R/W	4	0	3	1	
		19		2	0	2	1	W	0	0	0	1	
		19.5		7	0	7	1	R/W	1	0	0	1	
		20		3	1	4	1	R/W	0	0	0	1	
		20.5		6	0	6			0	0	1	0	
		21	B	6	0	6			0	0	2	0	
		21.5		4	0	4			0	0	0	0	
		22		4	1	5			0	0	0	0	
		22.5		3	0	3			0	0	0	0	
		23		4	0	4			0	2	0	0	
		23.5		0	0	0			0	0	0	0	
TOTALS				1117	107	1195	10		171	11	29	117	

a-d As in Appendix 2.1.

Appendix 2.41. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN #	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
OCT 29	3	0	8	8	1	9			0	0	0	0	
		.5		0	0	0			0	0	0	0	
		1		3	0	0			0	0	0	0	
		1.5		0	0	0			0	0	0	0	
		2		0	0	0			0	1	0	0	
		2.5		0	0	0			0	0	0	0	
		3		2	1	3			0	0	0	1	
		3.5		0	0	0			0	0	0	0	
		4		1	1	2			0	0	1	0	
		4.5		0	0	0			0	0	0	0	
		5	6	3	0	3			0	0	0	0	
		5.5		0	0	0			0	0	0	0	
		6		2	0	2			0	0	0	0	
		6.5		0	0	0			0	0	0	0	
		7		5	0	5			0	0	0	0	
		7.5		0	0	0			0	0	0	0	
		8		5	1	6			0	0	0	0	
		8.5		0	1	1			0	0	0	0	
		9		5	1	6			0	1	0	0	
		9.5		5	1	6			0	0	0	0	
		10		0	1	1			0	0	0	0	
		10.5		5	1	6			0	0	0	0	
		11		4	2	6			1	0	1	0	
		11.5		4	2	6			0	1	0	0	
		12		19	2	21			0	1	1	0	
		12.5		0	2	2			0	1	0	0	
		13	1	20	4	24			0	1	1	2	
		13.5		18	1	19			2	1	1	1	
		14		16	2	18			4	1	0	2	
		14.5		7	1	8			1	0	0	0	
		15		7	1	8			0	0	1	2	
		15.5		2	3	5			2	0	0	3	
		16		9	0	9	1	R/Y	2	0	0	0	
		16.5		16	1	17	1	B	3	0	0	1	
		17		18	2	0			1	1	1	2	
		17.5											
		18											
		18.5											
		19											
		19.5											
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				184	32	193	2		16	9	7	14	

[a-d] As in Appendix 2.1.

Appendix 2.42. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN 0	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
OCT 31	3	6.5	8	4	1	5			0	0	0	0	
		7		2	0	2			0	0	0	0	
		7.5		2	0	2			0	0	0	1	
		8		5	0	5			0	0	1	1	
		8.5		3	0	3			0	0	0	2	
		9		4	0	4			0	0	0	1	
		9.5		5	2	7			0	0	0	3	
		10		3	0	3			0	0	0	0	
		10.5		2	0	2			0	0	0	0	
		11		3	3	6			0	1	0	1	
		11.5		5	3	8			0	0	0	0	
		12		4	2	6			0	0	0	0	
		12.5		2	1	3			0	0	0	1	
		13	9	7	1	8			0	0	0	0	
		13.5		2	0	2			1	0	0	0	
		14		5	0	5			1	0	0	2	
		14.5		3	1	4			0	0	0	0	
		15		6	0	6			0	0	0	0	
		15.5		5	0	5			1	0	0	1	
		16		13	3	16			2	0	0	2	
		16.5		15	1	16			0	0	2	1	
		17		7	1	8			0	0	0	0	
		17.5											
		18											
		18.5											
		19											
		19.5											
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				107	19	126	0		5	1	3	16	

[a-d] As in Appendix 2.1.

Appendix 2.43. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN 0	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
		6.5											
		7											
		7.5											
		8											
		8.5											
		9											
		9.5											
NOV 5	3	10	9	4	0	4			0	0	0	0	
		10.5		0	0	0			0	0	0	0	
		11		0	0	0			0	0	0	0	
		11.5		0	0	0			0	0	0	0	
		12		2	0	2			0	0	0	0	
		12.5		7	1	8			0	0	0	0	
		13		5	3	8			0	0	0	0	
		13.5		4	1	5			0	0	0	0	
		14		1	1	2			0	0	0	0	
		14.5		3	0	3			0	0	0	0	
		15		3	1	4			0	0	0	0	
		15.5		5	2	7			0	0	0	0	
		16		6	0	6			0	0	1	0	
		16.5		3	2	5			0	0	0	0	
		17											
		17.5											
		18											
		18.5											
		19											
		19.5											
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				43	11	54	0		0	0	1	0	

a-d As in Appendix 2.1.

Appendix 2.44. Stamp falls fishway 1984, daily counts of salmon by half-hour intervals.

DATE	WATER LEVEL[a]	TIME[b]	OBS CODE[c]	CHIN ADLT	CHIN JKS	CHIN TOT	CHIN @	TAGS COL[d]	COHO	COHO JKS	SOCK	STLD	COMMENTS
		0											
		.5											
		1											
		1.5											
		2											
		2.5											
		3											
		3.5											
		4											
		4.5											
		5											
		5.5											
		6											
		6.5											
		7											
		7.5											
		8											
		8.5											
NOV 6	2.1	9	B	2	0	2			0	0	0	0	
		9.5		2	0	2			0	0	0	0	
		10		3	4	7			0	0	0	1	
		10.5		3	1	4			0	0	0	1	
		11		0	3	3			0	0	0	2	
		11.5		3	1	4			0	0	0	1	
		12		1	0	1			0	0	0	0	
		12.5		1	1	2			0	0	0	0	
		13		0	0	0			0	0	0	0	
		13.5		2	0	2			0	0	0	0	
		14		1	0	1			0	0	0	0	
		14.5		0	0	0			0	0	0	0	
		15		2	0	2			0	0	0	0	
		15.5		1	0	1			0	0	0	0	
		16											
		16.5											
		17											
		17.5											
		18											
		18.5											
		19											
		19.5											
		20											
		20.5											
		21											
		21.5											
		22											
		22.5											
		23											
		23.5											
TOTALS				21	10	31	0		0	0	0	5	

a-d As in Appendix 2.1.

Appendix 3. Operating procedure at the Stamp Falls fishway, and correction factors used to adjust for incomplete counts, September 6 - November 6, 1984[a].

Counting interval	Procedure	Correction factor
Sep 06-19	Day counts only, gate closed at night.	-
Sep 20-21	No counts, high water, gate open 24 h.	Mean of counts from day before and after.
Sep 22-26	Day counts only, gate closed at night, October 26 also partial night count.	-
Sep 27	24 h count.	
Sep 28-Oct 02	Day counts only, gate closed at night, September 28 and October 2 also partial night counts.	-
Oct 03	24 h counts.	-
Oct 04-06	Day counts, gate closed at night, October 4 also partial night count.	-
Oct 07-18	Flood, no counts, gate open throughout.	No fish passing due to velocity barrier and debris in fishway.
Oct 19-24	Day counts only, gate open 24 h, October 19 also partial night count.	Counts adjusted upward by 30% which is the proportion of fish migrating at night during the four days immediately after.
Oct 25	Day and partial night count, gate open 24 h.	-
Oct 26-28	24 h counts.	-
Oct 29	Day and partial night count, gate open 24 h.	-
Oct 30	No counts, gate open 24 h.	Mean of counts from day before and after.
Oct 31	Day count only, gate open 24 h.	-
Nov 01-04	No counts, gate open 24 h.	Mean of counts from October 31 and November 5.
Nov 05-06	Day counts only, gate open 24 h.	-

[a]See Table 3 and Appendix 2 for daily counts.

Appendix 4. Daily discharge for the Somass River at Station No. 08HB017, September - November 1984[a,b].

Day	Discharge (m^3/sec)		
	September	October	November
1	38.7	47.7	69.6[c]
2	36.9	46.3	71.0[d]
3	35.1	45.0	96.0[d]
4	34.8	46.6	143[d]
5	36.4	48.9	154[d]
6	35.2	49.4	165[d]
7	34.0	144	180[d]
8	33.4	365	176[d]
9	33.4	494	173[d]
10	33.6	598	170[d]
11	34.3	572	168[d]
12	35.5	538	165[d]
13	34.6	597	161[d]
14	37.9	538	158[c]
15	42.7	439	136
16	43.8	367	123
17	48.0	302	122
18	51.4	245	166
19	66.6	205	226
20	84.0	180	235
21	93.3	162	204
22	82.3	144	182
23	68.1	128	261
24	66.1	113	292
25	63.9	104	254
26	61.1	98.1	213
27	57.6	79.0	202
28	54.7	75.4	196
29	52.4	72.1	185
30	49.5	71.5	169
31	-	67.8	-
TOTAL	1,479.3	6,982.8	5,215.6

[a]Data from Water Survey of Canada, Vancouver; O. Nagy (pers. comm.)

[b]Station located 2 km below confluence of Stamp and Sproat Rivers.

[c]Manual gauge.

[d]Estimated.

Appendix 5. Percent and number of chinook females and males in each age class in the river dead recovery and in the estimated river escapement, Somass River system, 1984[a].

Age (years)	Females		Males		Total fish
	%	Number	%	Number	
		RIVER DEAD RECOVERY[b]			
2_1	0	0	11.9	662	662
3_1	2.9	267	22.8	1,267	1,534
4_1	77.4	7,132	58.4	3,246	10,378
5_1	19.7	1,816	6.9	384	2,200
Total	100	9,215	100	5,559	14,774
		ESTIMATED RIVER ESCAPEMENT[c]			
2_1	0	0	11.9	3,419	3,419
3_1	2.9	791	22.8	6,550	7,341
4_1	77.4	21,108	58.4	16,777	37,885
5_1	19.7	5,373	6.9	1,982	7,355
Total	100	27,272	100	28,728	56,000[d]

[a]Age composition by sex based on dead recovery data (Table 20).

[b]Sex composition for river dead recovies based on dead recovery data (Table 19)
[c]Sex composition for estimated river escapement based on combined dead recovery data and hatchery returns (48.7% females, 51.3% males, Table 19).

[d]From Table 12; excludes hatchery escapement.